MASTER'S THESIS

Public Health Nutrition

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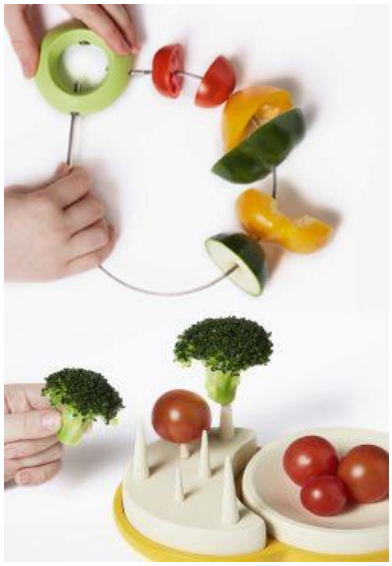
Play with your vegetables!

Can playful eating utensils increase children's vegetable consumption in shared kindergarten meals?



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PREFACE

The reason for choosing to conduct a study of vegetable consumption in kindergartens is my personal interest in children's nutrition and a wish to conduct research in a real-life environment. Eating habits are created early in life and track into adulthood, and children's development of food preferences is therefore an important field of Public Health Nutrition. Children are vulnerable and easily influenced, and as professionals, we have the opportunity to give children the best tools for sustaining good health through life. Working with the Master's thesis has been a fun and challenging process. Conducting a study from start to end has demanded a lot of thinking, decision making, learning of new skills and coordination on many levels. Though sometimes a bit overwhelming, the process has given me valuable experience in conducting research, which I am truly grateful for!

I want to thank the Norwegian Food research institute, Nofima, and The Oslo School of Architecture and Design (AHO). I want to thank the Department of sensory science, consumer and innovation at Nofima for giving me the opportunity to conduct this study and letting me be a part of the research environment. The Master's thesis is part of Nofima's strategic research programs, FoodSMaCK and InnoFood, funded by the Foundation for Research levy on Agricultural Products (FFL). I want to thank Ingunn for advice on statistical models, Mads Erling and Cuong for all your advice and practical help and Ida Synnøve for advice on recruitment. A special thanks to my supervisors at Nofima, Valérie Lengard Almli and Antje Gonera, for fruit (and vegetable)-ful discussions and quick and constructive feedback. Your high level of knowledge and enthusiasm, as well as your trust in my abilities, have been of great motivation through the whole process. Also, a special thanks to my supervisor at Oslo Metropolitan University, Asta Bye, for feedback and guidance.

I want to thank the kindergartens, children and parents participating in the study. Visiting the kindergartens was a fun part of the study and I enjoyed every minute of the kindergarten meals. Last, a big thanks to my assistants, Ida, Siri, Daniella, Ellen and Marte, your help, practical solutions, ideas and support have been of crucial matter to the study.

I hope this study can contribute to children's excitement towards vegetables. Because, as research indicates, we should indeed allow children to play with their vegetables!

Julie Aass

Oslo, May 2018

ABSTRACT

Background: Norwegian children's consumption of vegetables is below recommended levels (Hansen, Andersen, & Myhre, 2017). There has recently been a call for more research on the effect of playing with vegetables on children's consumption (Coulthard, Williamson, Palfreyman, & Lyttle, 2018).

Study aim: The aim is to examine whether playful eating utensils increase children's vegetable consumption in shared kindergarten meals by experimental testing of three utensils in real-life conditions; two utensils designed to promote play (landscape plate and flexible skewer) and a standard, white plate. In addition, a method for testing familiarity to vegetables directly with children, using picture cards, is developed and tested.

Results: The main study included 98 children, aged 4-6 years, and 71 parents. Mean consumption of vegetables per child was 67 grams higher when using the flexible skewer, compared to the white plate ($p<.05$). The amount of self-served vegetables per child was significantly higher when using the flexible skewer and the landscape plate, compared to the white plate ($p<.05$), 101 and 65 grams respectively. The amount of leftover vegetables (waste) was higher when using the playful eating utensils, compared to the white plate ($p<.10$). There were no differences in consumption or self-servings of unfamiliar vegetables between the testing conditions.

Conclusion: The study supports previous findings that suggest that play and crafting activities with vegetables can promote children's consumption. Using a flexible skewer seems like an effective method for increasing immediate consumption of familiar vegetables at group level in a shared kindergarten meal. The number of observations is low, and results must be interpreted with caution. More research is needed to test whether these findings generalize to other playful eating utensils and to examine the effect over time, effects on individual level and effects for children with food neophobia.

SAMMENDRAG

Bakgrunn: Norske barns inntak av grønnsaker er under anbefalte nivåer (Hansen, Andersen, & Myhre, 2017). Det har blitt etterlyst mer forskning på effekten av å leke med grønnsaker på barns inntak (H. Coulthard, Williamson, Palfreyman, & Lyttle, 2018).

Formål: Formålet er å undersøke om spiseredskaper som oppfordrer til lek øker inntak av grønnsaker i fellesmåltider i barnehagen gjennom eksperimentell testing av tre ulike redskaper i et naturlig miljø i barnehagen; to redskaper designet for å fremme lek (fleksibelt spyd og landskapstallerken) og en standard, hvit tallerken. I tillegg utvikles og testes en metode for å måle kjennskap til grønnsaker direkte med barn ved å bruke bildekort.

Resultat: Hovedstudien inkluderte 98 barn i alderen 4-6 år og 71 foreldre. Gjennomsnittlig inntak av grønnsaker per barn var 67 gram høyere ved bruk av fleksibelt spyd, sammenlignet med hvit tallerken ($p<.05$). Barna forsynte seg med henholdsvis 101 og 65 gram mer grønnsaker hver, da de brukte fleksibelt spyd og landskapstallerken, sammenlignet med den hvite tallerkenen ($p<.05$). Mengden grønnsaker som ble kastet (rester på tallerkenen) var høyere ved bruk av fleksibelt spyd og landskapstallerken, sammenlignet med hvit tallerken ($p<.10$). Det var ingen forskjeller i inntak eller mengde barna forsynte seg med av ukjente grønnsaker.

Konklusjon: Studien støtter tidligere forskning som indikerer at lek og det å lage håndverk/kunst med grønnsaker kan fremme barns inntak av grønnsaker. Å bruke et fleksibelt spyd ser ut til å være en effektiv metode for å øke det umiddelbare inntaket av kjente grønnsaker på gruppenivå i fellesmåltider i barnehagen. Studien inkluderer få observasjoner og resultatene må tolkes med forsiktighet. Mer forskning er nødvendig for å teste om disse resultatene er overførbare til andre spiseredskaper som oppfordrer til lek og for å undersøke effekt over tid, effekt på individnivå og effekt for barn med matneofobi.

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LIST OF ABBREVATIONS

AHO: Norwegian School of Architecture and Design

ANOVA: Analysis of variance

FV: Fruit and vegetables

LSD: Fisher's Least Significant Difference

N: Number

NCD: Non-communicable diseases

M: Mean

SD: Standard deviation

WMA: World Medical Association

WHO: World Health Organization

WORDLIST

Crafting: To make decorative articles by hand

Food neophobia: Fear of eating new or unfamiliar foods

Food pickiness: Unwillingness to eat familiar foods/try new foods and strong food preferences

Food preference: The selection of one food over another

Hands-on play activities: Activities involving touching with the hands

Multisensory/sensory play: Play activities focusing one or more of different sensory modalities (sight, smell, touch, taste, sound)

Self-servings: Amount of food the children serve themselves

Tactile play: Play activities focusing on the touching sense/tactile sense

The experimenter: The master's student (me)

1 INTRODUCTION

Norwegian pre-school children's consumption of fruits and vegetables is below the recommended level (Hansen et al., 2017). This is worrisome as food preferences are created early in life and track into adulthood, and low consumption of fruits and vegetables is associated with higher risk of disease and mortality (Aune et al., 2017; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011). Repeated taste exposure is known to be the most effective method for promoting the development of food preferences in children (Caton et al., 2013). Recent research indicates that play activities, involving real fruits and vegetables, increase immediate tasting and consumption and furthermore lead to increased exposure (Coulthard & Sahota, 2016). Play may work as a tool for introducing and familiarizing children to fruits and vegetables by using fun and exploration as a promoter. Scientists have recently called for more research on whether play activities can impact consumption of vegetables (Coulthard et al., 2018).

1.1 VEGETABLES: HEALTH BENEFITS AND RECOMMENDATIONS

Vegetables are edible parts of plants, such as leaves, roots, stems and flowers. The word vegetable derives from the Latin term "vegetabilis", meaning "to be enlivening or quickening" (Encyclopedia, 2018). Research has in many ways confirmed this early Latin perception of vegetables' effect on the body.

Vegetables usually contain little energy and are rich in fibres, vitamins and minerals. They also contain phytochemicals (Slavin & Lloyd, 2012). Most phytochemicals are antioxidants that have the potential to mitigate oxidative stress. Oxidative stress is a mechanism that is involved in a wide range of non-communicable diseases (NCDs), such as cardiovascular disease, cancer and type 2 diabetes (Slavin & Lloyd, 2012). It is likely that the overall effect of phytochemicals, in addition to vegetable's high content of fibres, vitamins and minerals, can explain the health benefits observed when consuming these foods. Also, a high intake of vegetables is often on expense of other foods that increase risk for developing NCD's (Helsedirektoratet, 2011).

Most research examines the health effect of fruit and vegetables (FV) combined. World Health Organization (WHO) states that approximately 1.7 million (2.8%) of deaths a year worldwide are attributable to low FV consumption (Boccia, Villari, & Ricciardi, 2015). Insufficient intake of FV is estimated to cause around 14% of gastrointestinal cancer deaths, about 11% of ischaemic heart disease deaths and about 9% of stroke deaths. Compared with individuals who eat less than three servings of FV each day, those who eat more than five servings have an approximately twenty percent lower risk of developing coronary heart disease or stroke (Boccia et al., 2015).

WHO recommends an intake of FV of at least 400 grams per day (World Health Organization, 2017). Norwegian authorities recommend an intake of at least 500 grams per day (50/50 fruits and vegetables), also known as "five portions a day". The recommendations are aimed at healthy adults, but are also applicable to children – one portion equalling to the size of a child's fist (Helsedirektoratet, 2011)

1.2 VEGETABLE CONSUMPTION

Consumption of FV varies globally between countries, but overall the intake is lower than recommended (Hall, Moore, Harper, & Lynch, 2009). Data from the World Health Survey showed that 77.6% of men and 78.4% of women in the world eat less FV than recommended. This applied to both high, middle and low-income countries (Hall et al., 2009).

The consumption of vegetables is lower than recommended in Norway. Only 15% of Norwegian men and 13% of Norwegian women follow dietary guidelines for consumption of vegetables (Svennerud et al., 2018). *Ungkost 3*, a nationwide survey of diet among 4-year-olds in Norway, showed that the average intake of vegetables, fruits and berries combined in this age group was 230 grams per day (Hansen et al., 2017). The report "*Utviklingen i norsk kosthold 2017*" states that one of the biggest nutritional political challenges in Norway is to increase the consumption of FV (Svennerud et al., 2018).

1.3 CHILDREN AND VEGETABLES

Vegetables are reported to be the least preferred food group among children and the food group most parents report to be challenging to introduce (Knai, Pomerleau, Lock, & McKee, 2006). Aversion for bitter taste and preference for sweet taste (energy-dense foods) and umami (protein rich foods) are innate (Ventura & Worobey, 2013). Children are biologically predisposed to be attracted to sweet taste and avoid bitter taste, presumably because of the sweet taste of breastmilk and the bitter taste of poisonous foods. The "survival of the fittest" can explain why children (and adults) prefer energy-dense foods - nature simply tells them that eating these foods can ensure survival. The low caloric compound and the bitter taste of vegetables can therefore help to explain why vegetables are unappealing to some children. However, these biological responses to the properties of vegetables can be overruled by social and environmental factors (Köster & Mojet, 2006).

1.4 VEGETABLE CONSUMPTION IN KINDERGARTENS

Children aged 4-6 in Norway spend much of their time in kindergarten and food and feeding practices in kindergartens influence children's diet and eating habits. A national survey of Norwegian kindergartens found that one challenge is the frequency in serving of vegetables, with only 36% serving vegetables every day (Paulsen, Høvding, Kristiansen, & Andersen, 2012). The challenge identified as the biggest in 2011 was to increase the supply of vegetables (Paulsen et al., 2012). There is need for examining methods that can be implemented in a kindergarten environment that increase children's liking for and consumption of vegetables. Methods that can make vegetables more popular and wanted amongst children, will give the kindergartens incentives for serving vegetables. Reported barriers for serving vegetables in the kindergartens are, among other things, a fear of having to waste a lot of food (Nicklas et al., 2001; Thurmann-Nielsen, 2011). Therefore, methods for increasing consumption in kindergarten, should also consider the impact on waste production.

2 THEORY

The following chapter presents relevant theory that the present study builds upon. The study is not based on one specific theory, but is based on a framework of different theories searching to explain the mechanisms involved in the development of food preferences in children and on research on methods for promoting healthy eating behaviours.

2.1 DEVELOPMENT OF VEGETABLE PREFERENCES IN CHILDREN

Food preference can be defined as the selection of one food over another (Rozin, 2006). As preferences are the main predictor of food intake in children (Drewnowski, 1997) it is important to understand how these preferences develop. Many studies have concluded that socioeconomic status correlates with healthy eating habits and vegetable consumption. The higher socioeconomic status - the higher the vegetable consumption (Kirby, Baranowski, Reynolds, Taylor, & Binkley, 1995; Shimotsu et al., 2012). Furthermore, demographic factors, gender, age and the home environment play important roles in the development of vegetable preference (Cooke et al., 2004; Kristiansen, Bjelland, Himberg-Sundet, Lien, & Andersen, 2017; Kristiansen, Bjelland, Himberg-Sundet, Lien, & Frost Andersen, 2017). In the home environment, availability, tradition, economy and habits affect the amount and types of vegetables children are exposed to (Neumark-Sztainer, Wall, Perry, & Story, 2003; Reinaerts, de Nooijer, Candel, & de Vries, 2007).

Children's food preferences are greatly affected by their parents' behaviour and attitudes towards foods. Studies indicate that children's food intake correlates with their parents' intake (Neumark-Sztainer et al., 2003). This is also the case for vegetables. Children of parents who eat a great amount of vegetables, tend to eat greater amounts of vegetables compared to children with parents who eat less vegetables (Draxten, Fulkerson, Friend, Flattum, & Schow, 2014). The impact of socioeconomic status, parent's eating habits and the home environment is however outside the scope of this thesis and will not be discussed further. The focus in this study is to examine methods for increasing consumption of vegetables in shared meals in kindergarten.

2.1.1 Biological components

From utero to preschool years, children are exposed to a variety of sensory stimuli affecting the development of food preferences (Köster & Mojet, 2006; Ventura & Worobey, 2013). Exposure to different tastes starts as early as in utero, followed by breast- and bottle feeding and later through the introduction of solid foods (Johnson & Hayes, 2017). Critical periods for developing food preferences are the stages of utero, breast- and bottle feeding, complementary feeding, weaning and the stage of food neophobia. Exposure to foods during these periods can create long-lasting preferences that track into adulthood (Birch, 1999). Food neophobia starts in many children by the age of two and is characterized by fear of tasting novel foods (Dovey, Staples, Gibson, & Halford, 2008). The fear is believed to be a biological response to protect the child from eating poisonous foods (Dovey et al., 2008). This behaviour can however reduce the likelihood of the child developing preferences for varied and healthy foods. This is especially a problem when it comes to vegetables, which often have bitter taste properties. Food neophobia can be stronger in some children than others, but for most children food neophobia is reduced when the child gets older.

Pickiness is when the child is familiar with the food, but rejects it (Howard et al., 2012). Picky children often have a lot of different foods they do not like, and many vegetables are often among them. The refusal of foods can be a way for the child to gain control and autonomy in the meal situation (Dovey et al., 2008). Consequently, it is important to focus on meal situations that ensure the child's feeling of autonomy in more beneficial ways, which increase and not decrease, the consumption of vegetables.

Individual biologically characteristics of the child, including genetic predispositions to bitter taste and other sensory sensitivities, like tactile sensitivity (Reed, Tanaka, & McDaniel, 2006), also impact the development of vegetable preferences and the child's overall acceptance of and willingness to taste vegetables (Coulthard, Harris, & Fogel, 2016).

2.1.2 Learning mechanisms

The development of food preferences is a result of different learning mechanisms, like reward based classical conditioning, operant conditions, associative conditioning and modelling (Capaldi-Phillips & Wadhera, 2014; Horne et al., 2011; Yeomans, 2006). Preferences for many

tastes, textures, and also warm foods, are due to learning mechanisms (Ventura & Worobey, 2013). For instance, adult's liking of coffee and beer, which have bitter taste properties, is a result of repeated exposure and the repeated experience of positive outcomes when consuming these drinks. The types of positive experiences that appear to promote vegetable acceptance include positive child feeding practices (for instance praise), associative conditioning processes involving other familiar flavours, called flavour-flavour learning, (Ahern, Caton, Blundell, & Hetherington, 2014) and post-ingestive consequences of consumption - all linked to the process of learning (Fisher & Dwyer, 2016).

Learning is essential for developing acceptance for vegetables. Through positive experience and by creating positive associations to vegetables, children can learn that vegetables are in fact tasty, filling and safe to consume (Capaldi-Phillips & Wadhera, 2014; Marty, Chambaron, Nicklaus, & Monnery-Patris, 2018). But in order for learning to occur, repeated exposure is important.

2.1.3 Repeated exposure

Repeated exposure is known to be the most effective strategy for developing preference for a novel food (Howard, Mallan, Byrne, Magarey, & Daniels, 2012; Schindler, Corbett, & Forestell, 2013; Zeinstra, Vrijhof, & Kremer, 2018). For children aged two years the acceptance seems to increase after 5-10 exposures, but for three- to four-year olds 15 exposures can be necessary (Howard et al., 2012). Repeated exposure contributes to the child's perception of the food as "safe". Repeated exposure has shown to be an effective approach for decreasing neophobic behaviour (Caton et al., 2013; Schwartz et al., 2011) and for increasing preschool children's acceptance for vegetables (Noradilah & Zahara, 2012). Methods that can promote initial exposure is therefore important. It is not only the number of exposures, however, but also the quality of children's experiences with food that influence acceptance, like the social environment.

2.1.4 Social influence

Eating can to a great extent be considered a social activity. From social environments children learn what is normally liked and disliked by observing what others eat and their reactions to different foods (Weber, King, & Meiselman, 2004).

In Norway, meals in kindergartens are mostly shared. The children either eat their own food brought from home or food is prepared in the kindergarten, and they usually sit together at one big table or in smaller groups around small tables. Norwegian guidelines for serving of foods in kindergartens state the importance of a positive and pleasant eating environment, with adults participating in the meal. The food that is served should be varied and vegetables and fruit or berries should be some of the meal components (Helsedirektoratet, 2007).

Kindergarten meals are a social arena that can affect development of food preferences in children (Himberg-Sundet et al., 2018). Observing adults and friends eating and enjoying foods, can encourage tasting of unfamiliar foods by the observational learning process called peer modelling (Yeomans, 2006). Tasting in a setting away from home can be especially important because food preferences are affected by factors at home, like parental food neophobia, socioeconomic status and education (Ventura & Worobey, 2013). In turn, the kindergarten can be an arena for equalization of socioeconomic differences related to health outcomes, as 91.3% of Norwegian children attend kindergarten (Statistisk sentralbyrå, 2018).

2.2 PRACTICAL MEAL METHODS FOR PROMOTING CONSUMPTION OF VEGETABLES

The way vegetables are served and presented, affects children's willingness to taste and eat the vegetables. Different practical methods have shown to increase consumption of vegetables in children, including larger portion sizes of vegetables (Spill, Birch, Roe, & Rolls, 2010), vegetables served with an accompanying dip (Fisher et al., 2012), serving a variety of vegetables (Bucher, van der Horst, & Siegrist, 2011) and cutting vegetables in different shapes (Olsen, Ritz, Kramer, & Moller, 2012). Children tend to eat more vegetables when vegetables are cut in pieces and when vegetables are offered before the main meal (Holley, Farrow, & Haycraft, 2017).

Forcing children to eat vegetables can lead to disliking of the present vegetable, while praise and encouragement can enhance intake (Blissett, 2011; Osborne & Forestell, 2012). It seems that encouraging children to taste a small bite of the new food is a better method to enhance food acceptance than telling the child to "eat up!". Allowing the child to spit out the food if disliked, can also increase the child's willingness to taste new foods (DeCosta, Moller, Frost, & Olsen, 2017).

The child's sense of autonomy may also affect his or her willingness to try a novel food (DeCosta et al., 2017). By letting children participate in meal preparations, children can get a stronger feeling of ownership and choice in a subsequent eating situation. Several studies indicate that participating in kitchen garden activities has a positive effect on vegetable intake in children (DeCosta et al., 2017). By involving children in the process of growing and preparing foods the children can get more familiar with the foods. Another way of familiarising children to vegetables, that shows promising results, is to let children explore vegetables through play (Kessler, Wansink, Zampollo, Shimizu, & Atakan, 2017).

2.2.1 "Don't' play with your food!" A misconception?

Scientists have stated that there has been a recent shift towards using play activities and games to increase novel food consumption (Coulthard et al., 2018; Kessler et al., 2017). Play is an important learning tool for children and essential for a healthy development in terms of cognitive, social, emotional and physical development (Milteer & Ginsburg, 2011). Recent studies have encompassed play with food (Coulthard & Sealy, 2017) and crafting (making decorative articles by hand) with vegetables and the impact on subsequent vegetable consumption and tasting (Sanne, Ellen, & Emely, 2017). These methods allow multisensory exploration and exposure to the appearance, smell, sound and feel of foods - without the pressure to taste. Focusing on different sensory properties of foods, other than the obvious taste properties, may be a method for promoting initial exposure and food acceptance in children. This method uses food as a play substance and eating is not the focus.

A review from 2012 examined if healthy eating programmes should incorporate interaction with foods in different sensory modalities (Dazeley, Houston-Price, & Hill, 2012). The authors found that several studies on the effectiveness of garden-based projects and sensory exploration programmes have produced encouraging results, in terms of producing short-term positive

effects on children's willingness to consume new foods. The authors concluded by calling for further research into the potential for familiarisation different sensory properties of FV to enhance children's willingness to consume a variety of FV (Dazeley et al., 2012). The authors followed this up themselves and conducted a study at the University of Reading in 2015. They found that children participating in sensory play with FV (involving tasting, touching and smelling combined with play activities), ate more FV in a subsequent meal, compared to children who only explored taste. The authors concluded that multisensory play with FV can promote consumption in children (Dazeley & Houston-Price, 2015).

A study published in 2017 investigated the effect of sensory play with real FV on children's willingness to taste FV and collected data on baseline liking and consumption of foods. (Coulthard & Sealy, 2017). Sixty-five 3-4-year-old children were randomly allocated to either create pictures using real FV (sensory play), create pictures using non-food items (sensory non-food play) or watch the researcher carry out the sensory play task (visual exposure). Coulthard and Sealy found that sensory play with real FV made children taste significantly more in total in a subsequent taste session, compared to both the non-food- and visual exposure-condition. They concluded that the findings suggested that "introducing food in a sensory play environment, which allows children to see, handle and smell foods, developing non taste sensory familiarisation, should be embedded in strategies to increase FV consumption" (Coulthard & Sealy, 2017). The largest benefits of the sensory play were seen for foods that were less familiar, such as pomegranate and kiwi. The authors also concluded by stating that future research should look at FV separately, as there is a trend in research and health professions towards distinguishing these foods. (Coulthard & Sealy, 2017; Osborne & Forestell, 2012).

2.2.2 Designing equipment to promote play

The size, colour and shape of eating utensils have shown to affect consumption and perception of foods (Piqueras-Fiszman, Alcaide, Roura, & Spence, 2012; Sobal & Wansink, 2007; Wansink, van Ittersum, & Painter, 2006). For instance, people tend to eat more when eating from big plates, compared to when eating from small plates (Van Ittersum & Wansink, 2012). Designers can use these insight to create designs that encourage certain eating behaviour

patterns while discouraging others (Hermanssdottir, Fisker, & Poulsen, 2012). In this way, designers can build up on research to make new designs that promote healthy eating.

2.2.3 Background of the present study: Playful eating utensils

The following sections explain the background of the present study. The Norwegian Food research institute Nofima has led a research project focusing on children's development of food preferences, the Children's Taste project ("*Children and food preferences in the light of the Norwegian Taste*" Project no. 233831/E50, financed by the Research Council of Norway). A collaboration between Nofima and The Oslo School of Architecture and Design (AHO) led to the idea of a student design project (Appendix A). Students at AHO were given the assignment of designing eating utensils that promote healthy eating in children.

In the first stage of the process, the students worked to obtain an in-depth understanding of the users. The students were introduced to the field of sensory science and development of food preferences in children by a researcher from Nofima. The students then visited kindergartens to observe children's eating behaviour in shared meals. They also interviewed children and kindergarten personnel. After summing up and discussions of the findings, three important aspects of the utensils were identified. To promote healthy eating the utensils should promote the following factors in an eating situation: *Creativity, participation and autonomy.*

Early prototypes of eating utensils were tested by children in a kindergarten (Appendix B). The children were asked to evaluate the proposed concepts, and the feedback was important input when the final sketches were made. The sketches were presented to Nofima at the project ending. Researchers chose two of the designs for prototyping and further testing; a *flexible skewer* and a *landscape plate* (cover photo, right). The utensils are tested in this thesis and are described in chapter 4.2 *Eating utensils*. Photos of the utensils are presented in Appendix J and K.

The students behind the designs stated that the main purpose of these two designs was to encourage children to play when they eat vegetables, and hence; develop an association between a fun activity and vegetables (associative learning). The goal was to make children touch and play with the vegetables and in a way feel more "in contact" with the vegetables (sensory exposure), while focusing on *creativity, participation* and *autonomy. Creativity* by letting the children craft and make decorations with vegetables, *participation* by encouraging all children

(even picky and food neophobic children) to touch and craft the vegetables without pressure to taste and *autonomy* by letting children serve themselves with their own choice of vegetables and create their own vegetable meal.

Quote from the designer behind the flexible skewer:

> The flexible skewer was designed to motivate children to taste new foods through participation and exploration. The tool is a link between eating with hands and using a tool. It facilitates the children's natural approach, which is to use hands and the tactile sense when eating. (Grimeland, 2018).

Quote from the designer behind the landscape plate:

> The landscape plate was designed to stimulate creativity and imagination and create good associations to healthy foods, by making the experience of eating fun and not formal and boring. Since the plate consists of several parts, that can be used both together and apart (and upside down), children can make different "layouts" for each meal and use their creative abilities so that eating vegetables becomes interesting. (Gaden, 2018).

Neither AHO nor Nofima plan on commercialising the products tested in the present study. Nofima states that the reason for testing the utensils is to gain scientific insights into children's eating behaviour and that there are no commercial interests involved (see *Ethical considerations* in chapter 4.5 for more information).

3 STUDY AIMS

3.1 OBJECTIVE 1: PLAYFUL EATING UTENSILS' IMPACT ON VEGETABLE CONSUMPTION

The main objective of the present study is the following:

- To examine whether playful eating utensils increase consumption of vegetables at group level in a shared meal in kindergarten.

The study compares three utensils; two utensils designed to promote play with food (flexible skewer and landscape plate) and one standard, white paper plate (see 4.2 *Eating utensils*). Impact on consumption of six different vegetables is examined (cucumber, cherry tomato, cauliflower, squash, red cabbage and bell pepper). The main research question is:

Can playful eating utensils increase children's vegetable consumption in shared kindergarten meals?

3.2 RESEARCH QUESTIONS

To answer the main research question, three secondary questions have been formulated.

Research question 1: *Do the tested eating utensils impact the amount of vegetables consumed and/or the amount of vegetables children serve themselves during the meal?*

The main factor (*independent variable*) in the study is the type of utensil. The factor has three levels, from here on referred to as testing conditions: White paper plate, flexible skewer and landscape plate (Figure 1). The *dependent variable* is the average (mean) amount of vegetables consumed per child in grams. Data are collected on group level, and the mean value per child is calculated by dividing the total weight of vegetables eaten in a kindergarten by the number of children participating in the meal.

To test if the utensils (*independent variable*) impact how much vegetables the children serve themselfes, the study examines the mean amount of self-servings (*dependent variable*) in grams per child. The total amount on group level is divided by the number of children participating in the meal.

Research question 2*: Do the tested eating utensils impact the type of vegetables consumed and/or the type of vegetables children serve themselves during the meal?*

An objective is to examine whether the eating utensils (*independent variable*) impact the choice of vegetables, as a bigger variety of fruits and vegetables in the diet can promote the development of preferences (De Cosmi, Scaglioni, & Agostoni, 2017; Nicklaus, 2016; Osborne & Forestell, 2012). The *depended variable* is the mean amount of each vegetable consumed in grams per child, calculated by dividing the consumption on group level on the number of children participating in the meal.

Research question 3: *Do the tested eating utensils impact the amount of unfamiliar vegetables consumed and/or the amount of unfamiliar vegetables children serve themselves during the meal?*

An objective of the study is to examine whether the playful eating utensils (*independent variable)* can promote consumption of unfamiliar vegetables (*dependent variable*), as play activities can increase tasting of unfamiliar foods (Kessler et al., 2017). Data on familiarity and exposure to vegetables are extracted from a picture sorting task and from a parental questionnaire and are compared to consumption and self-servings in the testing conditions. The *depended variables* are the amount of consumption and self-servings of the vegetables that scores low on both familiarity reported by children and low on exposure reported by parents.

3.3 OBJECTIVE 2: PLAYFUL EATING UTENSIL'S IMPACT ON WASTE PRODUCTION

To gain insights on the practical feasibility of using playful eating utensils in shared kindergarten meals, an additional research question is formed in terms of the utensils effect on waste production:

Research question 4: *Do the tested eating utensils impact the amount of leftover vegetables*?

The amount of leftover vegetables (vegetables children serve themselves, but that are left on the plate/spitted out/the waste) is compared across each testing condition. The utensil is the *independent variable* and the *dependent variable* is the mean waste per child in grams,

calculated by dividing the leftovers on group level by the number of children participating in the meal.

3.4 OBJECTIVE 3: MEASURING FAMILIARITY TO VEGETABLES DIRECTLY WITH 4-6-YEAR OLD CHILDREN

The third objective is to develop and test a method for measuring vegetable familiarity directly with 4-6-year old children using picture cards based on previous pictorial tasks (Carraway-Stage, Spangler, Borges, & Goodell, 2014; Nilsen, 2010). Parental reports on exposure and children's reports on familiarity to vegetables will be compared, to examine if a picture sorting task can work as a method for measuring familiarity to vegetables directly with children in this age group. The results from children's reports on familiarity will also be compared to their actual consumption of vegetables in the testing conditions, as familiarity can predict consumption (Cooke et al., 2004). The results can give insights into the validity of the picture sorting task as a method for measuring familiarity and whether the method can be used in research. The study examines a possible first step towards validation.

The *exposure score* per vegetable will be calculated by finding the mean score (mean number of days in the last month the children have eaten the vegetable, ranging from 1-30) reported by parents in a web questionnaire. The *familiarity score* per vegetable is the percentage of children who report to have tasted the vegetable before (1-100%).

4 METHOD

4.1 STUDY DESIGN

The present study is a quantitative experimental study using a within-subjects crossover design and randomized order of testing conditions. In addition, the study includes a cross-sectional study of parental and children's reports on exposure and familiarity to vegetables.

The experimental design was chosen because quantitative data can give results on the impact of utensils on consumption and self-servings, by using measures of *weight* as the *dependent variable* and utensil as the *independent variable*. Within-subjects crossover design was chosen because the influence of confounding variables is reduced when using this design (Stoney & Lee Johnson, 2012) . In this design each child participates in all three testing conditions, to reduce the influence of confounding variables that can impact the results if using test and control groups. Furthermore, crossover designs are statistically efficient and require fewer subjects than non-crossover designs (Stoney & Lee Johnson, 2012).

4.2 EATING UTENSILS

Figure 1 shows the utensils tested in the study. Testing condition A is a standard, white paper plate. Testing condition B is a landscape plate - a yellow plastic plate with spears and a detachable bowl. Testing condition C is a flexible skewer that can be opened and closed. See Appendix J and K for pictures of the practical use of the utensils. The testing conditions are referred to as *white plate*, *landscape plate* and *flexible skewer* in the thesis.

A)

B)

C)

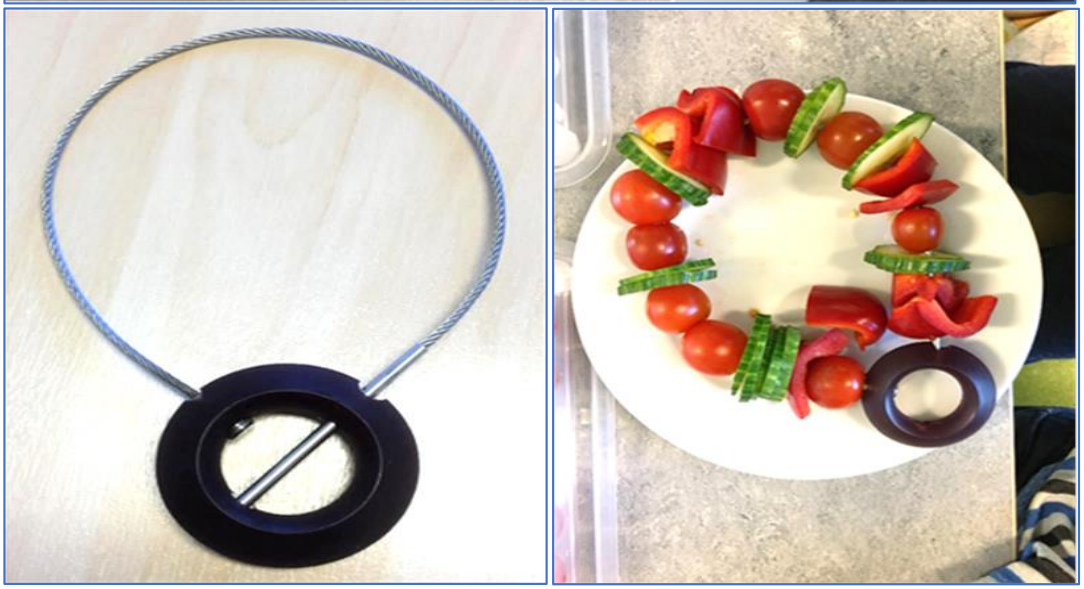

Figure 1: Utensils tested in the study. A) White plate B) Landscape plate C) Flexible skewer

4.3 STUDY FLOWCHART

The study includes several parts. The following flowchart (Figure 2) illustrates the different parts of the study from planning and development of methods (blue), to the data collection and the data analysis (green). The sections in the flowchart are described in the following chapters. The experimenter (the master's student/me) was responsible for, coordinated and participated in all study activities.

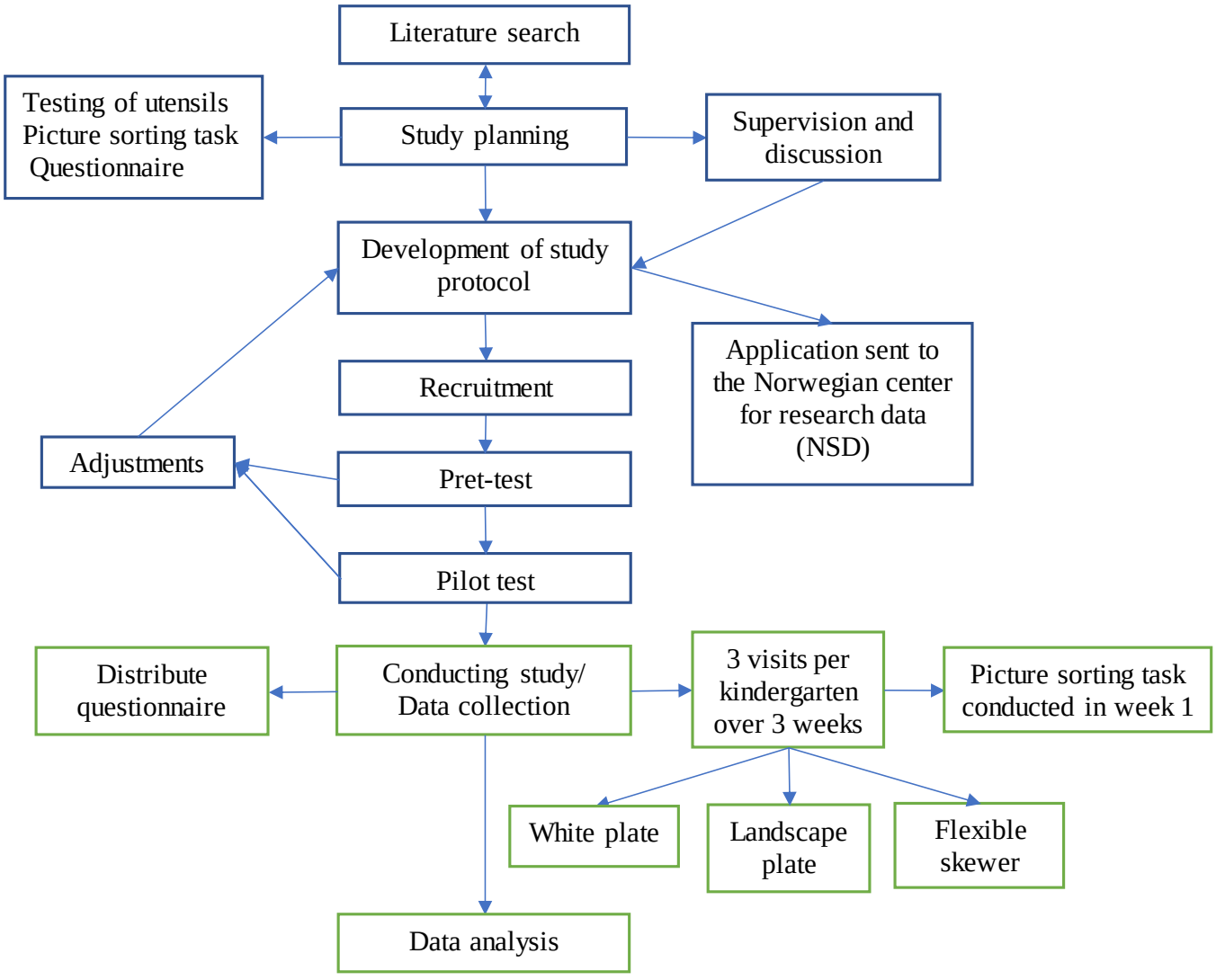

Figure 2: Flowchart showing milestones and activities in Part One (blue) and Part Two (green) of the study.

4.4 PART ONE: PLANNING AND DEVELOPMENT OF METHODS

Part One of the study involved the planning and development of methods used in the main testing. The choice of methods, including description and results from the pre-testing and pilot testing, are presented in this chapter.

4.4.1 Literature search

An online literature search was conducted using the search engines Science Direct, PubMed, Cochrane Library, Medline, Google Scholar and PsycInfo. Key terms related to children's consumption of vegetables and playing with food were used to identify potentially relevant papers. Key terms included *children, vegetables, exposure, consumption, playing with food, eating behaviour, development of food preferences, eating utensils, cutlery, kindergarten meals, sensory play, tactile play, introducing vegetables, crafting, serving style, acceptance, reluctance, food neophobia* and *picky eating* in various combinations, using the operators *AND*/*OR*. The search also led to automatic suggestions of similar articles in the research databases. Also, reference lists and citations in research articles were examined to explore relevant literature. Relevant literature was also provided by the supervisors at Nofima. All literature used in the present study is cited in the literature list.

4.4.2 Planning and development of experimental method: Testing of utensils

The protocol development took place in September and October 2017. The experimenter and two supervisors from Nofima developed a study protocol describing each section of the study, including participants, methods and materials, study progress and costs. The protocol was developed through several meetings, discussions and brainstorming. The experimenter presented the protocol to the Department of sensory science, consumer and innovation at Nofima. At this meeting the protocol was discussed further by scientists in the field and their thoughts and suggestions were taken into account in the further planning.

4.4.3 Photographic method

The original idea, as stated in the draft protocol, was to collect individual consumption data using a photographic method based on previous validated methods (Masis, McCaffrey, Johnson, & Chapman-Novakofski, 2017; Pouyet, Cuvelier, Benattar, & Giboreau, 2015). The plan was to take a photo of each child's plate after every new serving of vegetables and at the end of the meal, and then estimate consumption by comparing the photos (qualitatively and quantitatively). However, insights from the pilot testing led to the decision of not including this method in the main study (see 4.4.7).

4.4.4 Planning and development of method for testing children's familiarity to vegetables: Picture sorting task

The experimenter, in collaboration with supervisors at Nofima, developed a picture sorting task to test the children's familiarity to different vegetables based on a previous picture sorting task developed for 11-12-year old children (Nilsen, 2010). The previous task was developed and tested by a master's student in collaboration with Nofima and the University of Oslo in 2010. In the previous thesis, the method was considered suitable for testing school children's exposure to foods. Adjustments to the present study were done by choosing 26 pictures of only vegetables (the previous study included several food types) and by removing text, as the present study included younger children. Also, findings from another study evaluating a pictorial method for assessing liking of familiar fruit and vegetables among preschool children were taken into account (Carraway-Stage et al., 2014). This study showed that reliability and validity was acceptable for FV liking measure using pictures of fruit and vegetables. Insights from other similar studies on children also contributed to planning the method, like the use of pictures instead of text, letting play be part of the testing, keeping the test short so that the child doesn't get tired and making the test simple and easy to understand for the age group (Vennerød, Grini, Almli, & Hersleth, 2017).

4.4.5 Planning and development of method for testing previous exposure: Parental questionnaire

The web questionnaire involved a selection of 26 vegetables available in stores in Norway. The aim of the questionnaire was to examine which vegetables the children in the study were exposed to in the last 30 days and how often, and hence; which vegetables could be considered unfamiliar and familiar to the child. The questionnaire was based on a previous questionnaire on consumption of different foods used in the Children's Taste Project at Nofima (Vennerød, Almli, Berget, & Lien, 2017). Adjustments were done by including only vegetables. A goal was to make the questionnaire short and easy to answer to get the highest response rate as possible. The questionnaire included all the vegetables in the picture sorting task, so that the exposure score from parents could be compared to the children's familiarity score. The parental questionnaire was pilot tested by supervisors at Nofima. No other pilot testing was conducted as the questionnaire was considered to be short, understandable and easy to fill out and was reported to be a suitable tool for measuring frequency in consumption of different foods in the previous study (Vennerød, Almli, et al., 2017).

4.4.6 Pre-test of methods

Five children, aged 4-7 years, were recruited at Nofima (children and grandchildren of employees) for participation in a pre-test. The goal of the pre-test was to test the picture sorting task, the utensils, the photographic method stated in the draft protocol, the weighing method and coding of the children. Two assistants helped conduct the pre-test. Conclusions from the pre-test showed that several adjustments were necessary before the pilot testing.

Two children at a time conducted the picture sorting at the same table. The number of picture cards seemed suitable and the children said that the task was fun and understandable. It was however observed that some of the children may place the pictures randomly, for instance by reporting to not have tasted carrot, but to have tasted purple cauliflower. This was especially observed for the youngest children (4 years) and was therefore considered to be less of a problem when examining older children.

After the picture sorting, the children tested the utensils. The pre-test showed that some practical changes to the prototypes were necessary. The experimenter and supervisors meant that the ends of the flexible skewer were too sharp. This was solved by grinding down the ends. Some

metal parts fell out of the flexible skewers during the testing. Due to risk of the children swallowing these parts, the parts were removed from the utensil. The children reported to like the utensils and were offered to try the white plate, the landscape plate and the flexible skewer.

The method for collecting individual data by taking photos of the children's plates after servings and after the meal, described in the draft protocol, was also tested. The method seemed to work, except for the children being a bit disturbed and interested in the camera.

4.4.7 Pilot test in kindergarten

Ten children participated in the pilot testing in November 2017. The goal of the pilot testing was to test the study procedure and data collecting methods in a natural environment and a situation similar to the main testing. The pilot testing followed each step listed in the study protocol. Several important changes were made to the study protocol after the pilot testing and explain the choices of methods in the present study. The changes are described below.

The picture sorting task was conducted by asking three children to come join a table for a picture sorting game. To save time, the three children were given collective instructions and were asked to complete the sorting on their own. The pilot study showed that the children got affected by what the other children sorted. They looked at each other for "verification" and some children started competing on how many vegetables they had eaten before or how fast they could sort the vegetables. After discussions with supervisors on these insights, it was decided that the picture sorting task should be conducted with one child at a time –separate from the others. In practice in kindergartens, this could be done by sitting in a separate room or in a quiet corner in the kindergarten. The pilot study also showed that the children could get bored by waiting for their turn and that children should be offered to do something else while waiting. Further, the pilot showed that it was important to make the child feel safe and comfortable in the study situation. For children who expressed worry, a kindergarten employee was asked to sit beside the child while the child conducted the picture sorting.

Serving the vegetables from a buffet on a separate table, with one vegetable type in each box, did not work as planned (Appendix J). The children got confused and insecure because they were unfamiliar with the buffet setting. It was also disturbing for the meal situation when the children had to ask to serve themselves more and then get up and leave the table. The experimenter reported a high level of noise and an overall unpleasant eating situation. After a

while, the boxes were placed at the eating table. This resulted in more focus on the eating and lower level of noise and the children seemed to be more relaxed. However, the children only served themselves with the vegetable in front of them, because they could not reach the other vegetables (the vegetables were available, but not accessible). These insights led to changes to the study protocol; vegetables should be presented on smaller plates at the eating table and every child should have each type of vegetable in reachable distance. This change was also believed to affect the meal situation in a positive manner.

The original idea was to collect individual consumption data. However, the pilot showed that the photographic method (Masis et al., 2017; Pouyet et al., 2015), did not work out as planned in a real-life situation. Both the experimenter and the assistants reported the photographing to be disturbing to the meal situation. The children started asking about the photos and wanted the researcher to take more photos or wanted to look at the photos. Also, it was almost impossible to register when each child served themselves again. For instance, some of the children took one piece at a time, meaning that the experimenter and assistant had to take new pictures constantly (Appendix J). After discussions with supervisors, it was decided that the photographic method was too disturbing and complicated to conduct. A decision to only collect data on group level was made due to these insights.

4.5 PART TWO: MAIN STUDY

Part Two in the study included the main data collection. Recruitment and methods are described in this chapter.

4.5.1 Recruitment

The sampling method in the study was non-probability convenience sampling. Nearby kindergartens and kindergartens that had participated in one of Nofima's previous studies (involving different children), were invited to participate. Those kindergartens willing to participate were included. This sampling method was chosen because the kindergartens had to be in reachable location since the experimenter had to visit the kindergartens in person. The inclusion criteria were 1) age between 4 to 6 years 2) attending kindergarten and the exclusion criterium was 1) allergies towards any of the vegetables served in the tests. Kindergartens were

invited to join the study through e-mail (Appendix D). A follow up e-mail was sent to the kindergartens with the most children if the kindergarten did not respond. The experimenter had a meeting with each of the responding kindergartens to inform the personnel and plan and adjust the practical aspects of testing to each kindergarten. Alternative activities were planned for those children who, for various reasons, could not participate.

At these meetings, the student also brought the informed consent forms for the parents, to be returned to the kindergarten (Appendix E). The personnel at each kindergarten was asked to inform the parents about the study and distribute the sheets to the parents. The answer sheets were then either sent back to Nofima or picked up by the student at the kindergarten. Parents were asked to write down their e-mail address if they agreed to answer a questionnaire about their child's vegetable consumption.

4.5.2 Recruitment and training of assistants

Assistants were recruited through Nofima's external database of research assistants (bachelor and master students at The Norwegian University of Life Sciences) and the experimenter's own network. An assistant contributed in preparation of vegetables and data collection at each visit to the kindergartens. All assistants got training from the experimenter before testing. The training included training in preparation and weighing of vegetables, the testing procedure for testing of utensils and conduction of the picture sorting task (see Appendix F for information given to assistants).

4.5.3 Preparation of vegetables

The vegetables used in the testing of utensils were cucumber, white cauliflower, red cabbage, red bell pepper, cherry tomatoes and squash (Figure 3). The reason for choosing these vegetables was that they represent both typically familiar and unfamiliar vegetables. Furthermore, they were chosen because of practical reasons; they are easy to prepare, not too expensive, can be served raw and are soft enough to put on a skewer. The vegetables were bought at Rema 1000 and Coop Extra on the day of testing or the day before. The vegetables were washed in running water, then cut in slices or squares/pieces suitable for a child's hand

and mouth. The cucumber and squash were cut in slices and the red cabbage and bell pepper were cut in quarters. The cauliflower was parted into small bouquets or quarters and the cherry tomatoes were served whole. The vegetables were then separated in six boxes, one for each vegetable. The amount of each vegetable type was weighed and registered in a form (Appendix G).

Figure 3: Vegetables used in the testing conditions.

4.5.4 Testing sessions in the kindergartens

The main testing was conducted in six kindergartens in December 2017 and January and February 2018. All kindergartens were visited three times, one for each testing conditions. To control for a possible order effect affecting the results, the conditions were presented in a balanced order in each of the six kindergartens. The order for each kindergarten was randomly selected (Table 1).

Table 1: Order of testing conditions.

Kindergarten	Order of testing conditions A, B and C
1	A-B-C
2	A-C-B
3	B-A-C
4	B-C-A
5	C-A-B
6	C-B-A

The tests were conducted on the same week day and time of the day in each kindergarten in three following weeks. The reason for choosing the same day for each testing condition was that the weekday can affect how much vegetables the children eat. For instance, testing on Fridays, may mean that the children eat less vegetables because they are excited about the weekend and are looking forward to eating candy at home. Even more important, testing was on the same time of day because vegetable consumption can be affected by hunger and satiety, and hence, the time since the last meal. All the kindergartens in the study had meal time at 10-11 am. and again around 2 pm. The testing was conducted before the 2 pm meal, between 1 and 2 pm. in all kindergartens. The meal lasted from 35 to 45 minutes depending on how long the children sat by the table and other upcoming activities (for instance preparations of the 2 o' clock meal).

In the kindergarten, the vegetables were served separated in twelve to eighteen paper bowls on the table to make sure that every child could reach every vegetable type (Figure 4). The number of paper bowls depended on the number of children present. Each bowl was filled a little over the edge to look appealing. The children took place around one big or several small tables on their usual sitting places and were offered water to the meal. The experimenter then presented the utensil of the day and explained how it could be used by putting one piece of cucumber on the utensil. The children were then invited to start using the utensil and taste and eat what they wanted. They were told that they could spit out the vegetables if they did not like it and leave vegetables they did not want to eat on the plate. The experimenter gave no other instructions.

One or more of the kindergarten personnel were present during the testing. They were asked to help keeping noise down and to make sure that the children followed the experimenter's instructions. The kindergarten personnel were asked to keep as neutral as possible and not comment on the eating utensils, the vegetables or the children's eating. They were also asked to sit beside the table, but to not eat the vegetables. The experimenter and assistant took place at a table or chair beside the eating table (some meters in distance) and observed and took notes. To clarify and illustrate the testing method (to strengthen replicability), the assistants took some pictures of the table during the meal in all testing conditions – without commenting or interrupting the children (Appendix J). When the children said they were full/wanted to leave the table, they could leave the table. The meal duration was set to a maximum of 60 minutes. When all the children had left the table, the experimenters gathered the remaining vegetables in separate boxes and collected the vegetable leftovers (the waste) in separate bags. The experimenters then weighed the remaining vegetables and the leftovers.

The same procedure was followed at each testing in all the three testing conditions. The goal was to make the conditions as consistent as possible, except for the variation of eating utensil, to minimize biases that could affect the validity of the results.

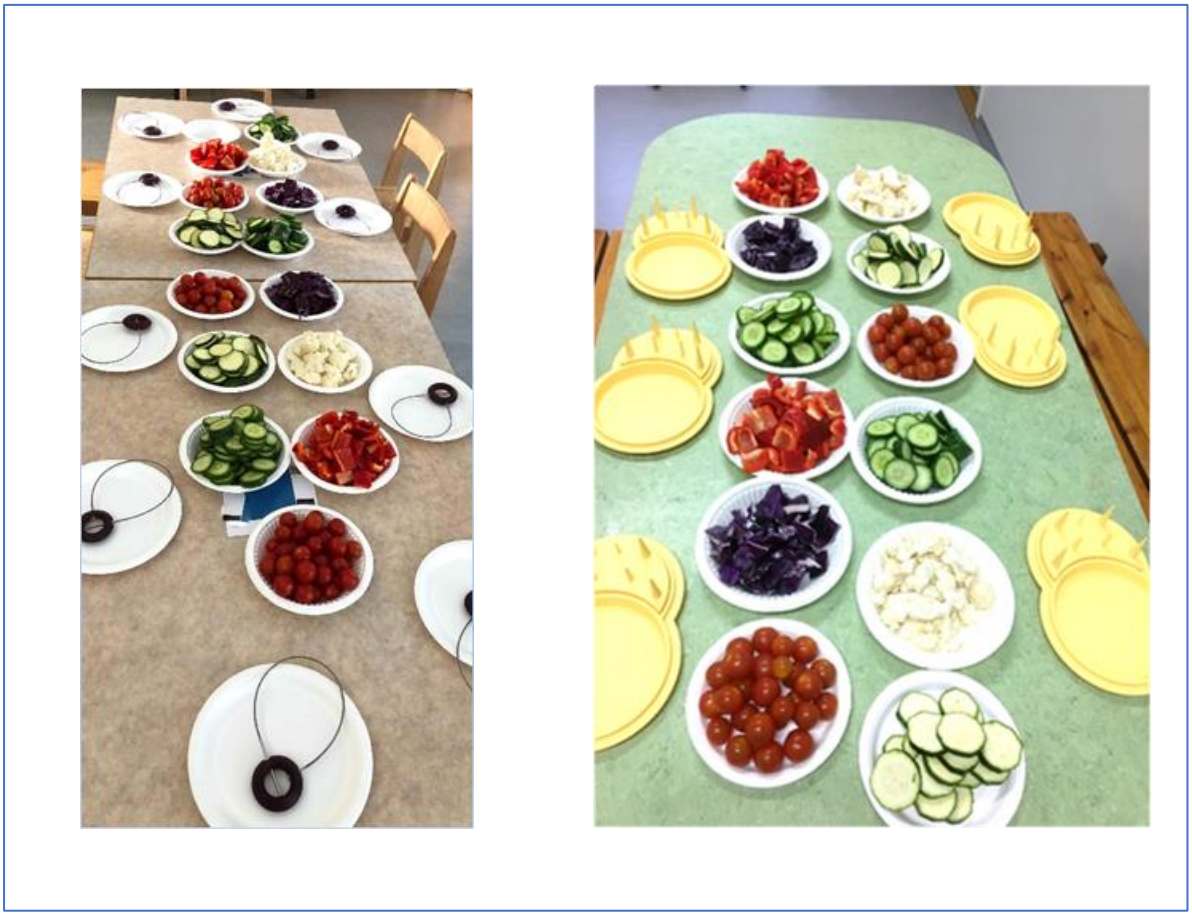

Figure 4: Setting of tables in shared kindergarten meal.

4.5.5 Measurement of consumption, servings and leftovers

To get the consumption value, the weight of the vegetables after the meal was subtracted from the weight of the vegetables before the meal. Weighing was performed for each of the six vegetable types separately. Leftover vegetables (vegetables children served themselves, but that were left on the plate/spitted out/the waste) were weighed separately from the other vegetables. The serving sizes were calculated by adding the consumption and leftover values. The kitchen scale used in the study had an accuracy of 1 gram. All values were entered in Excel and divided by the number of children participating in each meal to get a mean value per child.

4.5.6 Picture sorting task

The picture sorting task involved sorting 26 pictures of different vegetables into two categories; tasted before and not tasted before (Appendix H). The children were asked to look at one picture at a time and then place the picture on a yellow A4-sheet if they had tasted the vegetable before or a blue A4-sheet if they had not tasted the vegetable before. If they were unsure of having tasted it or not, they were asked to place the picture on blue. The experimenter and assistant tested one child at a time and helped in a neutral manner if the child was asking for advice. If the child asked what vegetable the picture showed, the assistant/experimenter said the name of the vegetable, followed by asking if the child had tasted or not tasted the vegetable before. For instance; "That's cauliflower. Have you tasted cauliflower before? If you have, place the picture on yellow. If you have not, place the picture on blue." The student and assistants had neutral responses, so that the children should not perceive the one answer as better than the other. The scene of the picture sorting task varied across the kindergartens. In some kindergartens the task was conducted at a separate table or a separate room and in others, on the floor in a quiet corner (Figure 5).

Figure 5: Picture sorting task.

4.5.7 Parental questionnaire

The parental questionnaire enquired about the child's consumption of 26 different vegetables in the last 30 days and was created in the software EyeQuestion® Sensory Software (logic8, The Netherlands) (EyeQuestion, 2016). The questionnaire included a horizontal 5-point Likert-scale with the alternatives *not eaten the last 30 days - a couple of times - about once a week - several times a week - daily or almost daily.* The child's ID code, birth year and gender were also collected through the questionnaire (Appendix I). The link was sent out when each kindergarten started the testing and the questionnaire was open to all parents until the end of February 2018.

4.5.8 Data entering and coding

Serving, consumption and leftovers from each kindergarten were first entered in Excel and mean values were calculated. The values were rounded to two decimals. The data were then entered in SPSS, one kindergarten representing one case (n=6). The testing conditions were coded as a categorical dummy variable 1=white plate, 2=landscape plate and 3=flexible skewer.

Data from the picture sorting task were entered in another SPSS data file. Gender was coded 1=boy and 2=girl. Birthyear was coded 1=2012, 2=2013 and 3=2014. Familiarity of vegetables was coded 1=tasted before and 0=not tasted before.

The data from the web questionnaire were automatically exported to SPSS from EyeQuestion. To simplify the data analysis, the data were recoded into the approximate number of days the child had eaten the vegetable in the last 30 days. Not eaten the last 30 days =0, a couple of times=2, about once a week =5, several times a week =15 and daily or almost daily=30. This recoding allows treating the data on a continuous numerical scale.

4.5.9 Statistical analysis

All data were analysed using the SPSS® Statistics Version 24.0 software (IBM, 2016). Statistical significance was set at two-sided p-value of <.05. Results with p-value <.10 were also registered and discussed because the sample size was small, and this may affect the detection of statistical significant differences (6 cases or kindergartens) (Altman, 1991).

First the data (dependent variables) were explored by checking for outliers and normality using descriptive statistics, histograms and boxplots. Normality of the data was tested by comparing histograms of the sample data to a normal probability curve and by evaluation of skewness and kurtosis. Then, the variance in the three groups were compared using Levenes's test to check the assumption of homogeneity of variance for carrying out analysis of variance (ANOVA) (Altman, 1991; Pallant, 2007).

One-way analyses of variance (ANOVAs) were carried out to examine differences between means in the three testing conditions. When using ANOVA, the comparison of three means takes the general form of an F test to compare variances (Pallant, 2007). Post-hoc tests, using Fisher's Least Significant Difference (LSDs), were carried out if the overall ANOVA showed a significant difference somewhere between the three testing conditions. Post-hoc test consists of pairwise comparisons that are designed to compare all different combinations of the testing conditions and were therefore considered suitable for comparing the three utensils (Altman, 1991). LSD multiple comparison test was chosen because it is reported to be suitable for the comparison of three means and for controlling for Type 1-errors (incorrect rejection of a true null hypothesis) (Hayter, 1986; Levin, Serlin, & Seaman, 1994).

4.5.10 Observational notes

During all study activities, the experimenter took observational notes. These observations are not to be considered a defined study method in the present study, but the observations contribute to the discussion of results and strengths and limitations of the study. The notes are not presented systematically, but are referred to in the discussion chapter.

4.5.11 Ethical considerations

World Medical Association (WMA) gives ethical guidelines for research on children through The Declaration of Helsinki (World Medical Association, 2008). Children are defined as a vulnerable group, and an important criterion for research on children is that research should benefit the child. This project is considered to benefit the participating children, as the study includes free tasting and consumption of vegetables, without the pressure to taste or eat, in a

safe and familiar environment in the kindergarten. The incentives given in the recruitment process were free vegetables at three vegetable meals and participation in a fun and playful vegetable meal.

Informed consent was given by the parents on behalf of the children. In addition, it was important to inform the participating children about the project in a way the children could understand. It was also important to tell the children that they could choose not to participate in the project, even though their parents had agreed. The experimenter was given permission to take photos of children in three of the kindergartens. The question about photos was not included in the first informed consents, but parents and kindergartens were asked later through e-mail. To protect the children's identity, no pictures of the children's faces are included.

The protocol for the present study was notified to The Norwegian Centre for Research Data (NSD) in October 2017, reference 56088 (Appendix C). ID-numbering was used in all the methods (testing in kindergartens, picture sorting task and parental questionnaire) to ensure anonymity while keeping trac of participants. The data were deidentified by making a connection key between the ID-number and name, which was stored apart from the data. All the collected data were kept in the students locked case or in the student's personal PC, locked by two passwords. Collected information will be anonymized by 31.08.2018. Anonymization involves processing the data so that no individuals can be recognized by deleting connection keys.

The flexible skewer and the landscape plate are results of a student assignment at AHO. AHO have stated that they will not produce the utensils or present them for sale. The students at AHO do however have the copyright to the designs. Nofima may use the utensils and results from the present study in further research and publications. The experimenter conducting the study has no affiliation with AHO or Nofima other than that of the present study. The experimenter does not get a salary from any of the institutions.

All study costs were covered by Nofima, including production costs of the prototypes (20 items of each playful utensil), assistants' salaries, vegetables used in the testing, equipment like plastic bags and gloves and transportation costs. The Master's thesis is part of Nofima's strategic research programs, FoodSMaCK and InnoFood, funded by the Foundation for Research levy on Agricultural Products (FFL).

5 RESULTS

5.1 STUDY PARTICIPANTS

The following flowchart shows participants and drop-outs in the study.

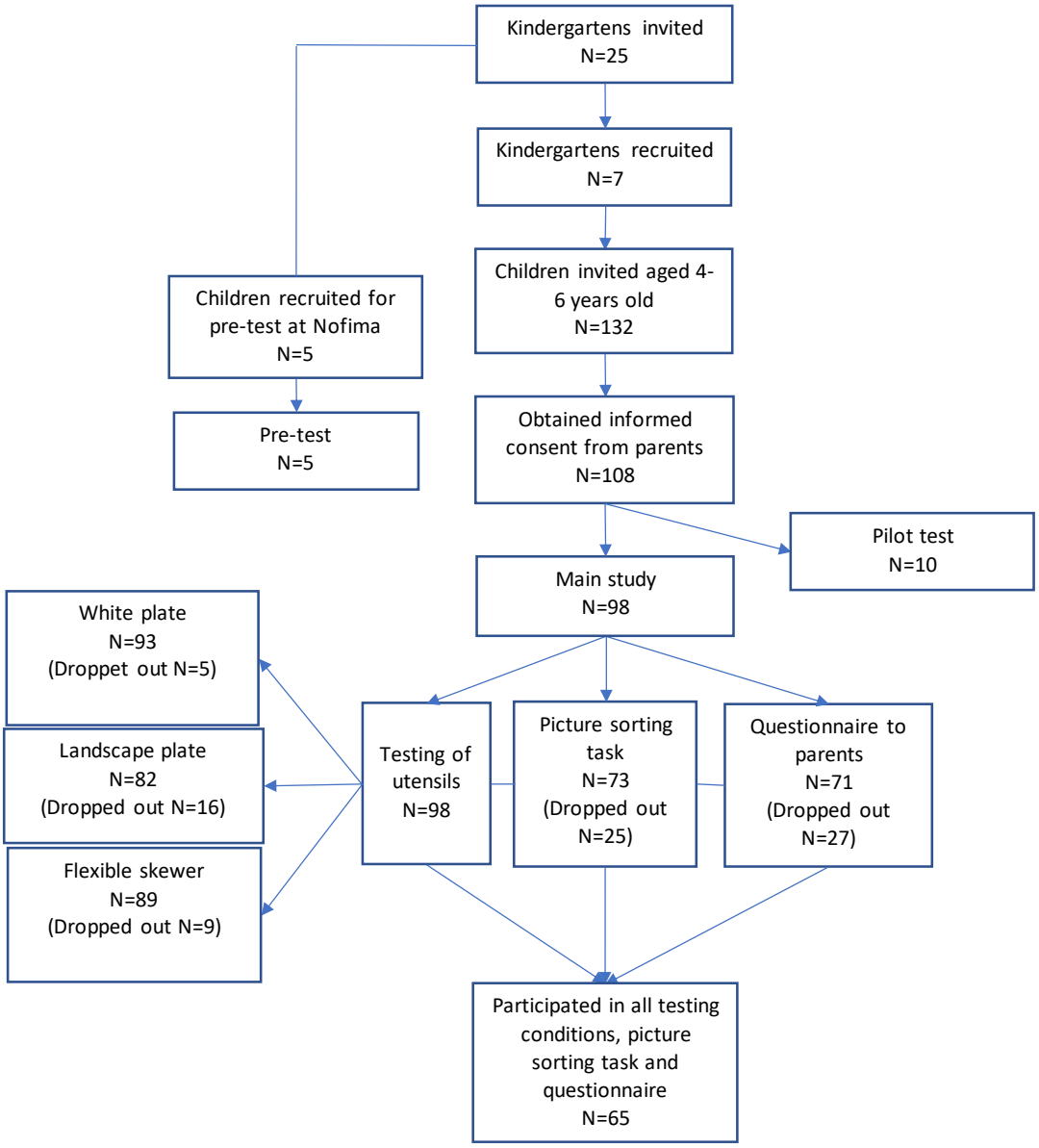

Figure 6: Flowchart showing participation in the study. A total of 113 children participated in the study (pre-test, pilot test and main study combined). Of 98 children in the main study, 82 children tested all three utensils. 65 children participated in testing of all three utensils, picture sorting task and had a parent answering the questionnaire.

The primary study population was 4-6-year-old children in kindergartens in Norway. Seven kindergartens were recruited. Five of the kindergartens had previously been part of the research project, Children's Taste, at Nofima, but not with the same children. One kindergarten, with ten children, participated in the pilot study and six kindergartens, each with groups of 10-20 children, participated in the main testing.

The invitation to participate in the study was sent to 25 kindergartens. Two kindergartens declined, and sixteen kindergartens did not respond. In total, 113 children participated in the study, including pre-test and pilot test. Five children participated in the pre-test and ten other children participated in the pilot study. Ninety-eight children participated in the main study and completed one or more of the three testing conditions and/or the picture sorting task and/or the parental questionnaire. Eighty-two children tested all three utensils. Sixty-eight of the children participating in the picture sorting task had a parent answering the questionnaire (68 matches of ID-numbers). Sixty-five of the children tested *all three* utensils, conducted the picture sorting task and had a parent answering the questionnaire (Figure 6). Of these 65 children, 51% were boys. 48% were six years old, 42% five years old and 10% four years old (Table 2). Vegetable consumption, self-servings and leftovers were collected at group level. Therefore, all children present at each testing were included in the analysis and results per child were calculated using the group score. In the analysis, each of the six kindergartens in the main testing presented one case/one observation (Table 3). The groups referred to in the ANOVA tables (Between Groups/Within Groups) are the testing conditions.

One child was excluded because of vegetable allergy (allergy towards tomato). Other drop-outs from testing of utensils and the picture sorting task were due to illness, vacations or the child being picked up earlier than planned (often on Fridays) and other unknown reasons for the child's absence in the kindergarten. No children withdrew from participation. Drop-outs from the questionnaire were due to no response from parents.

Table 2: Participant characteristics

Number of children who completed all study activities (testing of three utensils, picture sorting and parental questionnaire)	65
Gender	Girls: 48% Boys: 51%
Age	4 years: 10% 5 years: 42% 6 years: 48%

Table 3: Participating kindergartens and children.

Kindergarten	Number of children in the kindergarten group
1	16
2	15
3	10
4	20
5	18
6	19

5.2 IMPACT ON TOTAL CONSUMPTION AND SELF-SERVINGS OF VEGETABLES

Research question 1: *Do the tested eating utensils impact the amount of vegetables consumed and/or the amount of vegetables children serve themselves during the meal?*

Table 4 shows total mean consumption of vegetables per child in each of the testing conditions. An ANOVA was conducted to explore the impact of eating utensil on the mean total consumption of vegetables (grams) per child (Table 5). There was a statistically difference at the p<.05 level in total consumption between the three conditions: F (4, 885) = 2.15, p=.02. Post-hoc comparisons using LSD indicated that the mean total consumption when using the flexible skewer (M=224, SD=35) was significantly higher compared to total consumption when using the white plate (M=157, SD=49) (Table 5). The mean total consumption per child was 67 grams higher when using the flexible skewer compared to the white plate (Table 6, Figure 7). The consumption when using the landscape plate did not differ significantly from either the flexible skewer or the white plate (M=189, SD=23) (Table 6).

Table 4: Total mean consumption of vegetables per child (grams) in the three testing conditions. 93 children tested the white plate, 82 children tested the landscape plate and 89 children tested the flexible skewer in six different kindergartens using crossover design.

Total consumption of vegetables per child (grams)

			95% Confidence Interval for Mean	
	Mean	Std. Deviation	Lower Bound	Upper Bound
White plate	157	49	105	208
Landscape plate	189	23	165	214
Flexible skewer	224	35	188	260
Mean consumption in all testing conditions combined	190	45	168	212

Table 5: Differences in mean total consumption of vegetables per child between the three testing conditions examined using one-way ANOVA.

ANOVA Total consumption of vegetables

	df	F	Sig.
Between Groups	2	4,885	**,023***
Within Groups	15		

*The mean difference is significant at the 0.05 level.

Table 6: Differences in mean total consumption of vegetables per child (grams) between the three testing conditions

Post-hoc comparisons (LSD) Total consumption of vegetables

		Mean		95% Confidence Interval	
(I) Utensil	(J) Utensil	Difference (I-J)	Sig.	Lower Bound	Upper Bound
White plate	Landscape plate	-32	,152	-78	13
	Flexible skewer	**-67***	**,007**	-113	-21
Landscape plate	White plate	35	,152	-13	78
	Flexible skewer	-34	,127	-81	11
Flexible skewer	White plate	**67***	**,007**	21	113
	Landscape plate	35	,127	-11	81

*The mean difference is significant at the 0.05 level.

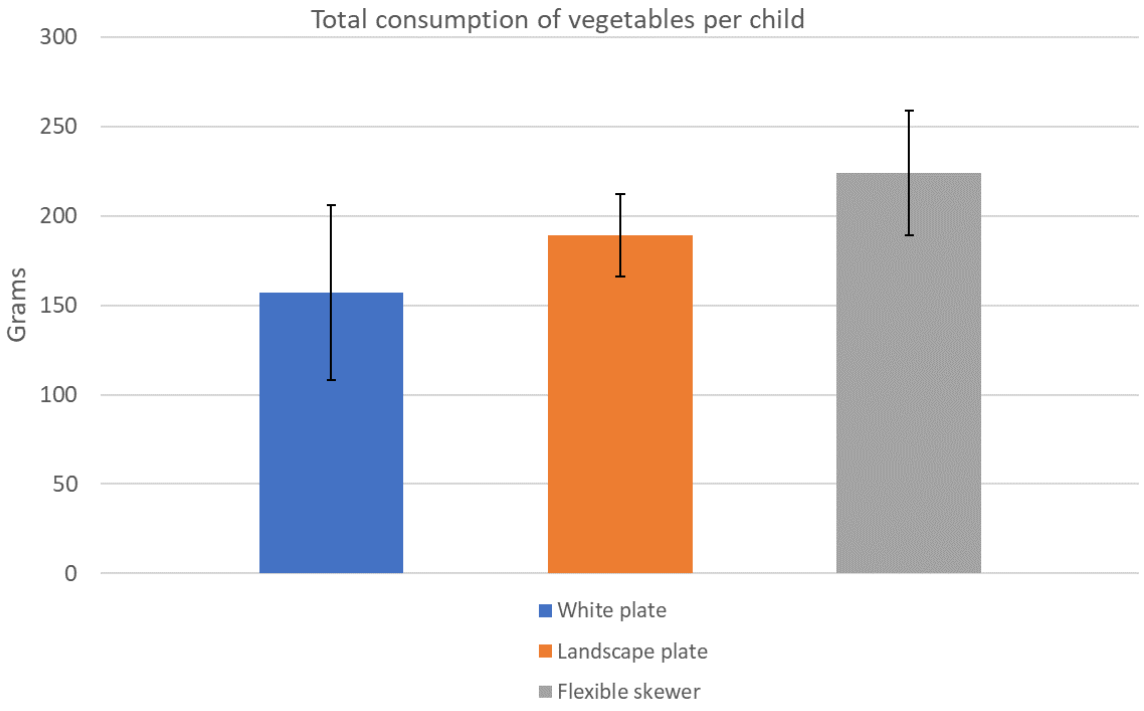

Figure 7: Total mean consumption of vegetables in the three testing conditions.

Table 7 and Figure 8 show mean self-servings in each of the testing conditions. An ANOVA was conducted to explore the impact of eating utensil on the mean self-servings of vegetables (grams) per child (Table 8). There was a statistical difference at the p<.05 level in self-servings between the three conditions: F (6, 985) = 2.15, p=.007. Post-hoc comparisons using LSD indicated that the mean self-servings when using both the flexible skewer (M=303, SD=49) and the landscape plate (M=266, SD=26) were significantly higher compared to self-servings when using the white plate (M=202, SD=61) (Table 9). The mean self-servings per child was 101 grams higher when using the flexible skewer and 65 grams higher when using the landscape plate, compared to the white plate (p=.002, p=.03) (Table 9).

Table 7: Mean self-servings of vegetables per child (grams) in the three testing conditions.

Self-servings of vegetables per child (grams)

			95% Confidence Interval for Mean	
	Mean	Std. Deviation	Lower Bound	Upper Bound
White plate	202	61	137	267
Landscape plate	266	26	239	293
Flexible skewer	303	49	252	354

Table 8: Differences in mean self-servings of vegetables per child between the three testing conditions examined using one-way ANOVA.

ANOVA Self-servings

	df	F	Sig.
Between Groups	2	6,985	**,007***
Within Groups	15		

*The mean difference is significant at the 0.05 level.

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Table 9: Difference in mean self-servings of vegetables per child (grams) between the three testing conditions.

Post-hoc comparisons (LSD) Self-servings of vegetables

		Mean		95% Confidence Interval	
(I) Utensil	(J) Utensil	Difference (I-J)	Sig.	Lower Bound	Upper Bound
White plate	Landscape plate	**-65***	,033	-123	-6
	Flexible skewer	**-101***	,002	-160	-43
Landscape plate	White plate	**65***	,033	6	123
	Flexible skewer	-37	,201	-95	22
Flexible skewer	White plate	**101***	,002	43	160
	Landscape plate	37	,201	-22	95

*The mean difference is significant at the 0.05 level.

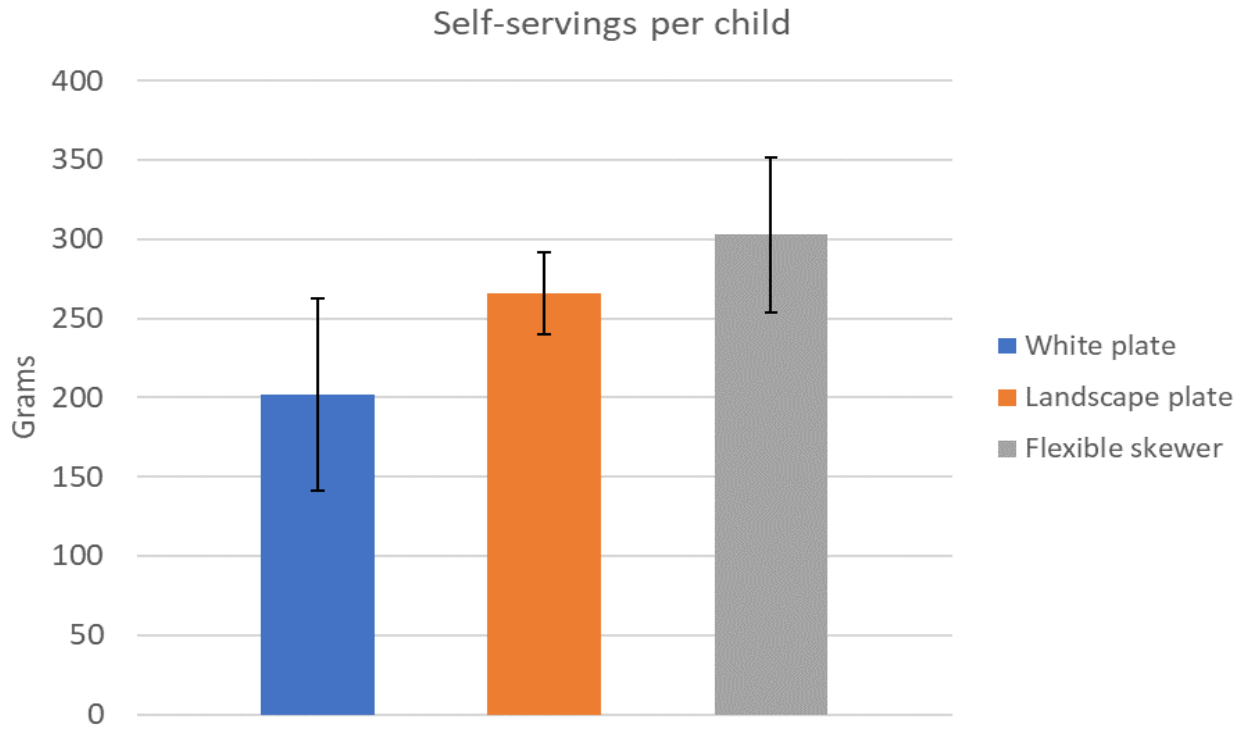


Figure 8: Self-servings in the three testing conditions.

5.3 IMPACT ON TYPES OF VEGETABLES CONSUMED AND SELF-SERVED

Research question 2: *Do the tested eating utensils impact the type of vegetables consumed and/or the type of vegetables children serve themselves during the meal?*

Figure 9 and Table 10 shows mean consumption and self-servings of vegetable types in the three testing conditions. Overall, cucumber, cherry tomato and bell pepper had the highest consumption rate and cauliflower, red cabbage and squash had the lowest consumption rate in all testing conditions combined. There were no significant differences in type of vegetables consumed in the testing conditions, except for cucumber (Table 10). Post-hoc comparisons using LSD indicated that the mean consumption of cucumber per child was 32 grams higher when using the flexible skewer, compared to the white plate (p=.008) (Table 11). Self-servings of cucumber were significantly higher when using both the flexible skewer (56 grams, p=.002) and the landscape plate (34 grams, p=.03), compared to the white plate. Self-servings of cauliflower were significantly higher when using the flexible skewer compared to the white plate (p=.04) (Table 11).

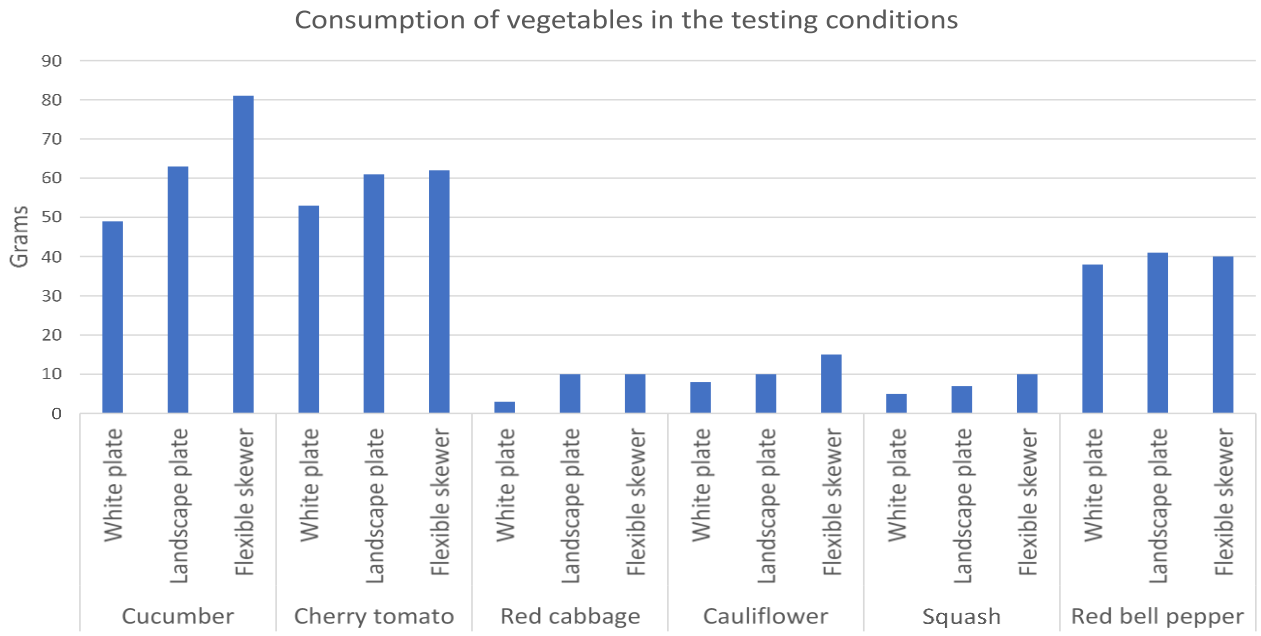


Figure 9: Mean consumption of vegetable types per child (grams) in the three testing conditions

Table 10: Mean consumption and self-servings of vegetable types per child (grams) in the three testing conditions

Type of vegetables consumed and self-served per child (grams)

		Consumption			**Self-servings**	
		Mean	Std. Deviation		Mean	Std. Deviation
Cucumber	White plate	49	17	White plate	65	25
	Landscape plate	63	19	Landscape plate	99	16
	Flexible skewer	**81***	17	Flexible skewer	**121***	32
Cherry tomato	White plate	53	32	White plate	55	37
	Landscape plate	61	28	Landscape plate	74	30
	Flexible skewer	62	37	Flexible skewer	79	36
Red cabbage	White plate	3	3	White plate	3	3
	Landscape plate	10	15	Landscape plate	13	14
	Flexible skewer	10	9	Flexible skewer	11	11
Cauliflower	White plate	8	7	White plate	10	7
	Landscape plate	10	7	Landscape plate	19	11
	Flexible skewer	15	10	Flexible skewer	**25****	15
Squash	White plate	5	7	White plate	10	10
	Landscape plate	7	4	Landscape plate	18	7
	Flexible skewer	10	8	Flexible skewer	21	13
Red bell pepper	White plate	38	20	White plate	39	20
	Landscape plate	41	11	Landscape plate	43	11
	Flexible skewer	40	13	Flexible skewer	46	13

*The mean difference between two or more of the testing conditions is significant at the 0.05 level in the ANOVA

** The mean difference between two or more of the testing conditions is significant at the 0.10 level in the ANOVA

Table 11: Differences in mean self-servings of cucumber and cauliflower per child (grams) between the three testing conditions. Poct-hoc conducted after significant ANOVAs.

Post-hoc comparisons (LSD) Consumption and self-servings of cucumber and cauliflower per child (grams)

			Mean Difference		95% Confidence Interval	
	(I) Utensil	(J) Utensil	(I-J)	Sig.	Lower Bound	Upper Bound
Cucumber consumption	White plate	Landscape plate	-14	,200	-36	8
		Flexible skewer	**-32***	**,008**	-54	-10
	Landscape plate	White plate	14	,200	-8	36
		Flexible skewer	-18	,108	-40	4
	Flexible skewer	White plate	32*	,008	10	54
		Landscape plate	18	,108	-4	40
Self-servings cucumber	White plate	Landscape plate	**-34***	**,034**	-65	-3
		Flexible skewer	**-56***	**,002**	-87	-25
	Landscape plate	White plate	**34***	**,034**	3	65
		Flexible skewer	-22	,153	-53	9
	Flexible skewer	White plate	**56***	**,002**	25	87
		Landscape plate	22	,153	-9	53
Self-servings cauliflower	White plate	Landscape plate	-10	,163	-24	4
		Flexible skewer	**-15***	**,041**	-29	-,7
	Landscape plate	White plate	10	,163	-4	24
		Flexible skewer	-5	,453	-19	9
	Flexible skewer	White plate	**15***	**,041**	,7	29
		Landscape plate	5	,453	-9	19

*The mean difference is significant at the 0.05 level.

5.4 IMPACT ON UNFAMILIAR VEGETABLES CONSUMED AND SELF-SERVED

Research question 3: *Do the tested eating utensils impact the amount of unfamiliar vegetables consumed and/or the amount of unfamiliar vegetables children serve themselves during the meal?*

Results from the picture sorting task were registered in SPSS and a mean familiarity score for each vegetable was calculated (Table 12). The data from the children showed that carrot, cucumber, bell pepper, mini corn and sweet peas were the vegetables the highest percentage of children had tasted before. Eggplant, artichoke, beetroot, red cabbage and purple cauliflower scored lowest on familiarity.

Results from the parental questionnaire were exported to SPSS and a mean exposure score for each vegetable was calculated, mean number of days in the last month that the child had eaten the vegetable (Table 12). Cucumber, carrot, bell pepper, tomato and garlic had the highest exposure score. Artichoke, purple cauliflower, eggplant, red cabbage and radish scored lowest on exposure.

Red cabbage scored low on both familiarity and exposure and was therefore considered an unfamiliar vegetable in the testing. It was however no significant difference in consumption or self-servings of red cabbage between the three testing conditions (Table 13) and the overall consumption and self-servings of red cabbage was low (Figure 9, Table 10).

Table 12: Results from testing of familiarity (picture sorting task with children) and exposure (parental questionnaire).73 children participated in the picture sorting task and 71 parents answered the questionnaire (68 parent/child matches). The green boxes show the vegetables that scored highest on familiarity and exposure. The orange boxes show the vegetables with the lowest scores. Results are presented as means. Vegetables included in the testing appear in bold.

*Red cabbage was the vegetable used in the testing that scored low on both familiarity and exposure

Vegetables (sorted from most familiar to least familiar)	**Familiarity score** Percentage of children that report to have tasted the vegetable before	**Vegetables (sorted after frequency in consumption the last month, reported by parents)**	**Exposure score** Number of days the child has eaten the vegetable the last month, reported by parents
Carrot	94,5 %	**Cucumber**	17,24
Cucumber	91,8 %	Carrot	11,92
Bell pepper	80,8 %	**Bell pepper**	9,58
Mini corn	75,3 %	Tomato	8,96
Sweet peas	72,6 %	Garlic	7,61
Tomato	70,3 %	**Cherry tomato**	6,59
Cherry tomato	65,8 %	Onion	6,25
Broccoli	58,9 %	Broccoli	5,49
Cauliflower	58,9 %	Salad	3,55
Salad	52,1 %	**Cauliflower**	3,07
Avocado	49,3 %	Avocado	2,87
Brussels sprouts	46,6 %	Sweet peas	2,59
Squash	43,8 %	Mini corn	1,83
Leek	37,0 %	Leek	1,80
Onion	37,0 %	Beetroot	1,35
Spinach	32,9 %	Spinach	1,18
Radish	26,0 %	**Squash**	1,01
Celery	24,7 %	Celery	0,96
French beans	23,3 %	Asparagus	0,79
Asparagus	21,9 %	Brussels sprouts	0,59
Garlic	21,9 %	French beans	0,51
Purple cauliflower	20,5 %	Radish	0,39
Red cabbage*	13,7 %	**Red cabbage***	0,37
Beetroot	12,3 %	Eggplant	0,37
Artichoke	11,0 %	Purple cauliflower	0,08
Eggplant	11,0 %	Artichoke	0,06

Table 13: Differences in mean consumption and self-servings per child (grams) of red cabbage (the vegetable in the testing that scored low on familiarity and exposure) between the three testing conditions.

ANOVA Unfamiliar vegetable (red cabbage) consumption and self-servings

		df	F	Sig.
Red cabbage consumption	Between Groups	2	,981	,398
	Within Groups	15		
	Total	17		
Self- servings of red cabbage	Between Groups	2	1,506	,254
	Within Groups	15		
	Total	17		

5.5 IMPACT ON VEGETABLE WASTE

Research question 4: *Do the tested eating utensils impact the amount of leftover vegetables?*

Table 14 and Figure 10 shows the waste produced (the amount of leftovers) in each of the testing conditions. An ANOVA was conducted to explore the impact of eating utensil on the mean leftovers of vegetables (waste) (grams) per child (Table 15). There was a statistically difference at the p<.10 level in leftovers between the three conditions: F (3, 433) = 2.15, p=.059. Post-hoc comparisons using LSD indicated that the mean leftovers per child when using both the flexible skewer (M=42, SD=33) and the landscape plate (M=34, SD=28) was significantly higher, compared to the leftovers when using the white plate (M=6, SD=6) at the p<.05 and p<.10 level (Table 16). The mean leftovers per child was 36 grams higher when using the flexible skewer (p=.02) and 28 grams higher when using the landscape plate (p=.08), compared to the white plate (Table 16).

Table 14: Mean waste per child (grams) in the three testing conditions.

Vegetables wasted per child (grams)

			95% Confidence Interval for Mean	
	Mean	Std. Deviation	Lower Bound	Upper Bound
White plate	6	6	-,3	13
Landscape plate	34	28	5	63
Flexible skewer	42	33	8	77
Mean vegetable waste in all testing conditions combined	26	28	13	42

Table 15: ANOVA examining differences in mean waste per child (grams) between the three testing conditions.

ANOVA Vegetables wasted

	df	F	Sig.
Between Groups	2	3,433	**,059****
Within Groups	15		

*. The mean difference is significant somewhere between the three testing conditions at the 0.10 level.

Table 16: Differences in mean waste per child (grams) between the three testing conditions.

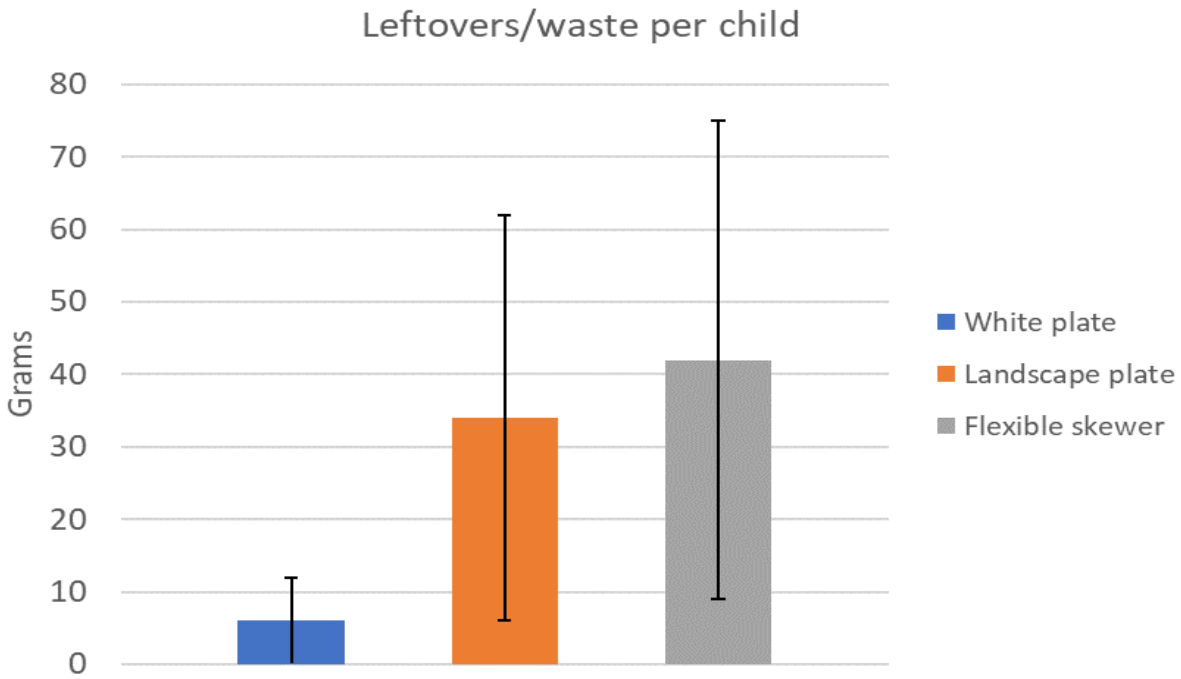
Post-hoc (LSD) Differences in mean amount of vegetables wasted per child (grams)

		Mean Difference		95% Confidence Interval	
(I) Utensil	(J) Utensil	(I-J)	Sig.	Lower Bound	Upper Bound
White plate	Landscape plate	**-28****	**,076**	-58	3
	Flexible skewer	**-36***	**,024**	-67	-5
Landscape plate	White plate	**28****	**,076**	-3	58
	Flexible skewer	-9	,557	-40	22
Flexible skewer	White plate	**36***	**,024**	5	67
	Landscape plate	9	,557	-22	40

* The mean difference is significant at the 0.05 level.

** The mean difference is significant at the 0.10 level.

Figure 10: Leftovers/waste per child in the three testing conditions.



5.6 METHOD FOR MEASURING FAMILIARITY TO VEGETABLES DIRECTLY WITH CHILDREN

Figure 11 sums up results from the picture sorting task and the questionnaire. The children's report on familiarity were comparable to the parent's reports on exposure. Mini corn, sweet peas, brussels sprouts and squash scored high on familiarity compared to exposure. Garlic scored high on exposure compared to familiarity (Figure 11).

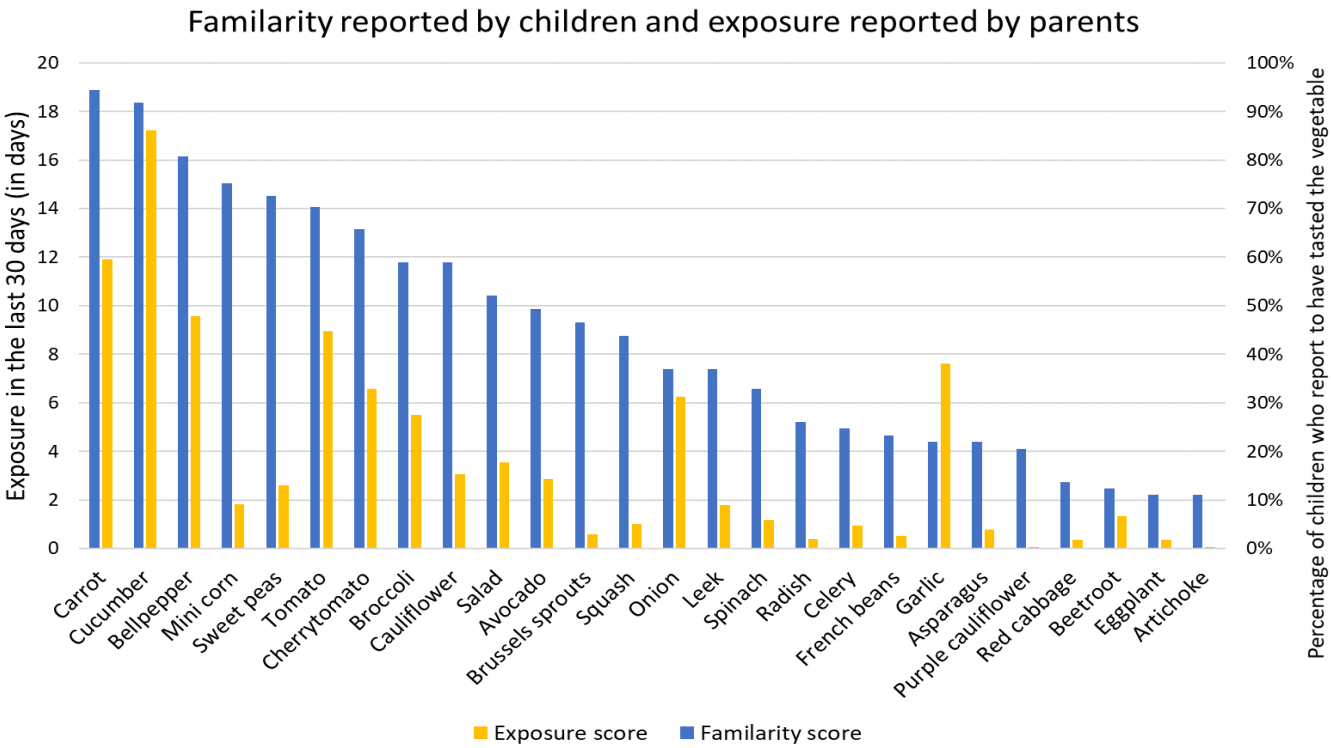


Figure 11: Comparison of results from the picture sorting task and the parental questionnaire.

Table 17 shows consumption of vegetables in the three testing conditions combined. The children's reports on familiarity were compared to overall consumption in all testing conditions combined. Vegetables that scored high on familiarity had the highest consumption rate (cucumber, cherry tomato and bell pepper) and the vegetable that scored lower on familiarity had the lowest consumption rate (cauliflower, squash and red cabbage) (Figure 12). Cauliflower and squash differed between familiarity and consumption and had relatively high familiarity scores compared to the consumption in the testing.

Table 17: Consumption of vegetables inn all three testing conditions combined.

Consumption of vegetables in all testing conditions combined

	Cucumber	Cherry tomato	Bell pepper	Cauliflower	Red cabbage	Squash
Mean (per child)	64 grams	59 grams	38 grams	11 grams	9 grams	7 grams
Std. Deviation	21	31	15	8	10	7

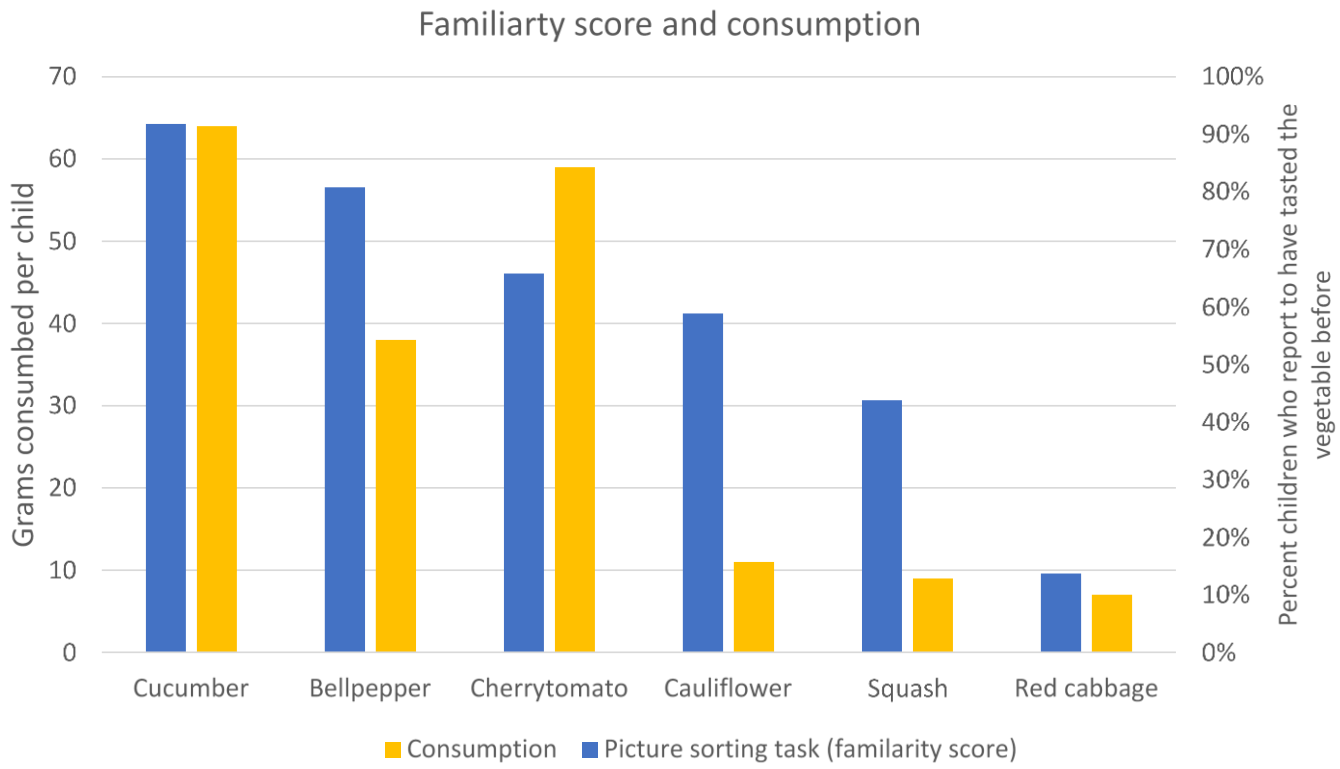


Figure 12: Comparison of familiarity reported by children in the picture sorting task and mean consumption of vegetables in all testing conditions combined.

6 DISCUSSION

6.1 SUMMARY OF RESULTS

The study found that the total consumption of vegetables increased significantly when using the flexible skewer, compared to the white plate (67 grams higher per child, $p<.05$). Total amount of self-servings was higher when using both the flexible skewer (101 grams higher per child, $p<.05$) and the landscape plate (65 grams higher per child, $p<.05$), compared to the white plate. The consumption of cucumber was significantly higher when using the flexible skewer (32 grams higher per child, $p<.05$), compared to the white plate and the self-servings of cauliflower was notably higher when using the landscape plate, compared to the white plate (15 grams higher per child, $p<.10$). Consumption and self-servings of red cabbage, the vegetable that scored low on both familiarity reported by children and exposure reported by parents, did not differ between the testing conditions. The results indicated that the amount of vegetables wasted (the leftovers) was higher when using the flexible skewer (36 grams higher per child, $p<.05$) and the landscape plate (28 grams higher per child, $p<.10$), compared to the white plate, but the spread around the means (SDs) in the data was high. The results from measurement of familiarity to vegetables in the picture sorting task overall corresponded with parental reports on exposure and the children's consumption in the testing conditions, but some of the vegetables showed differences in scores between familiarity, exposure and consumption.

Summing up, the playful eating utensils increased self-servings and consumption of familiar vegetables, but also increased waste (leftovers), compared to the standard, white plate.

6.2 OBJECTIVE 1: PLAYFUL EATING UTENSILS' IMPACT ON CONSUMPTION AND SELF-SERVINGS OF FAMILIAR AND UNFAMILIAR VEGETABLES

The results indicate that alternative eating utensils, that to a greater extent promote play and crafting compared to a traditional plate, may increase overall self-servings and consumption of familiar, but not unfamiliar vegetables. The findings of a possible positive effect of playing and crafting with vegetables are comparable with results from other studies where play is reported

to lead to increased consumption and tasting of vegetables (Coulthard & Sahota, 2016; Coulthard & Sealy, 2017; Coulthard et al., 2018; Holley et al., 2017).

The level of play in all testing conditions may explain the overall high intake of vegetable in the three testing conditions, all means ranging above 150 grams per child. Two of the utensils were designed to promote play and the third eating utensil was a standard, white plate. It is however difficult to distinguish between "play" and "not play" in the testing conditions, as children were given the same instructions in each of the conditions. Playing is a natural response for children when they get the chance to eat what and how they want and when tasting and spitting out the food/leave the food on the plate is accepted. Hence, playing with vegetables was observed in all the testing conditions. Even so, the playful eating utensils seemed to further increase the consumption and self-servings, possibly due to a larger creativity aspect on top of the effect of playing.

Sensory activities with food are considered effective in other studies. For example, "Taste for Life" was an intervention based on sensory learning which was developed to support nurseries in encouraging young children to eat healthy, which showed positive outcomes of sensory activities on vegetable consumption (Dazeley & Houston-Price, 2015). Play activities and crafting especially promote touching the vegetables with hands, meaning that the tactile sense is in focus. Several studies have shown positive effects on tactile sensory games on the consumption of vegetables (Coulthard & Sahota, 2016; Coulthard et al., 2018; Dazeley & Houston-Price, 2015; Dazeley et al., 2012; DeCosta et al., 2017). In Coulthard and Sealy's study from 2017, the children had to pick up the vegetables with their fingers, and they were encouraged to squash or reshape the foods with their hands if they wanted to (Coulthard & Sealy, 2017). This hands-on method, with the focus on tactile stimuli, can be a component in play situations that positively impact the children's willingness to taste and consume vegetables. By using hands to explore a vegetable, children can get more familiarised with its properties other than taste. It has also been reported a link between tactile sensitivity and food neophobia, pointing towards a connection between the tactile sense and acceptance of vegetables (Coulthard & Sahota, 2016; Kessler et al., 2017; Nederkoorn, Jansen, & Havermans, 2015). A review from 2017 of experimental research on how to change children's eating behaviour concluded that hands-on approaches, such as gardening and cooking programs, may encourage greater vegetable consumption and have a larger effect compared to nutrition education (DeCosta et al., 2017).

The flexible skewer was designed to promote *creativity, participation* and *autonomy* in the eating situation and the focus on these compounds can be related to other studies. It was observed that the children in the present study decorated and made crafts with the flexible skewer (Appendix J). Some of the children said that they made "necklaces" or "crowns". The focus on *creativity* and the effect of making vegetables crafts have been examined in other studies. In Coulthard and Sealy's study children were asked to create a picture using vegetables. The study found that the children who used real fruits and vegetables in the crafting activity tried significantly more fruit and vegetables post-activity than children in a non-food activity and a children in a visual exposure activity (Coulthard & Sealy, 2017). Another study from 2017 also examined the effect of crafting on preschool children's vegetable intake (Sanne et al., 2017). Eighty-six 4-6-year old children either crafted a peacock with vegetables or with non-food objects following an example. After the task, children were offered snack vegetables. However, this study did not show that crafting increased intake of vegetable snacks. A reason for this may be that the children had to follow specific instructions to perform the craft (a pre-made peacock). Due to this, creativity was not a component in the peacock study and this may have affected the results.

The positive effect of using the flexible skewer may also be explained by an overall enhanced *participation* in the play activity and the meal situation. Participation in meal preparation and growing/gardening has shown positive outcomes for acceptance of foods (DeCosta et al., 2017). The skewer was designed to promote participation for those children that tend to reject vegetables, by letting all children participate in the crafting regardless of their willingness to taste or eat the vegetables. This can be illustrated by the observation of how the children splashed cherry tomatoes with the skewer and started to discuss the inside of the tomatoes and how it looks and feels. It was also registered that children who overall tasted and ate very small amounts or no vegetables at all, also participated in the crafting. This shared exploration of vegetables may lead to more interest in the properties of vegetables that can encourage more of the children to taste.

The enhanced participation can also lead to a longer meal duration, where children gets more time to explore the vegetables and show less impatience in the eating situation. Previous studies have shown that insufficient time to eat is associated with significantly decreased vegetable consumption (Cohen et al., 2016). It was observed that the shortest meal durations were in the conditions using the white standard plate. The maximum meal duration was set to 60 minutes and all meals lasted between 35 to 45 minutes. Because autonomy was an important factor in

the conditions, the children were allowed to leave the table when they wanted and comparisons of meal durations between the testing conditions were therefore challenging. Children in the same meal left the table after varied durations – in some kindergartens two or one child sat up till ten minutes longer than the rest of the children. The factors mentioned above should however be examined through additional qualitative/quantitative observations and need further studies to explore effects over time.

All the testing conditions focused on voluntary tasting and the children got to choose exactly what they wanted to put on their plate. Providing a choice of vegetables can be an effective strategy for promoting *autonomy* in the eating situation. A study from 2012 included 150 children between 4 and 6 years and examined the effect of providing them with a choice of vegetables on their vegetable consumption (Rohlfs Domínguez et al., 2013). The choice conditions were associated with higher vegetable intake, in comparison to a no-choice control condition. The authors concluded that a higher degree of personal choice promoted consumption of vegetables (Rohlfs Domínguez et al., 2013) and the findings are confirmed in other studies (Olsen et al., 2012; Schwartz et al., 2011; Weber et al., 2004). A Norwegian study of food servings in kindergartens also states that autonomy is an important component in the eating situation and recommends that adults should respect children's right to have their own preferences (no preferences is right or wrong) and that children should be encouraged to serve themselves (Helland, Bere, & Øverby, 2016).

Further, the design of the flexible skewer may have had a direct influence on intake in terms of how much vegetables the children could fit onto the utensils and how easy it was to eat from the utensils. The skewer made it easy for the children to place a great amount of vegetables tightly, put the wire together and take bites directly with their mouths. This may be a fun and more satisfying way to eat vegetables, that can explain why the consumption was higher when using the skewer compared to the white plate and landscape plate. The landscape plate only had seven spears and was less challenging from a motor skills point of view and may be better suited for younger children.

Design of eating utensils has shown to affect intake in previous studies in adults (Piqueras-Fiszman, Laughlin, Miodownik, & Spence, 2012; Wansink et al., 2006), but not much research has examined the effect on children's consumption. There are however examples of other designs that have a goal of making the eating situation more fun, like "Construction Eating Utensils" were children eat their foods with a truck-lift fork, a wheel-loader spoon and a bulldozer scoop or "The Garden Fairy Utensils" which are advertised by "making eating fun

for kids so they'll want to eat their vegetables" (www. constructiveeating.com). Other examples are "The Lickety Spoon" that is marketed to bring playfulness to the dinner table and the "Airfork One," an airplane shaped spoon that is supposed to transform eating into a fun filled time. The effect of these utensils on consumption is however, to the experimenter's knowledge, not tested scientifically. Comparing the utensils in the present study with other playful eating utensils could be an object for further studies.

It is important to consider that the "newness" of the eating utensil can have affected the results. The flexible skewer presents something new and exciting and can therefore be more fun and engaging compared to a traditional plate. Other research has shown that vegetable intake in children increases when vegetables are cut in shapes, like stars and moons and that presenting vegetables in surprising ways appeals to children (Olsen et al., 2012). There is therefore need for investigating longer term effects of the flexible skewer and the landscape plate.

The type of utensil did not affect the consumption on unfamiliar vegetables significantly. The flexible skewer did however enhance intake of cucumber, which scored high on both previous exposure reported by parents and familiarity reported by children. Knowing that 15 exposures may be necessary to develop preference for this age group (Caton et al., 2013), the findings are not surprising and it was clear that the overall intake followed the reported familiarity of the vegetables. For the vegetables served in the testing, the familiarity score for each vegetable ranged from highest to lowest followed this order; cucumber, bell pepper, cherry tomato, cauliflower, squash and red cabbage. The overall mean intake in all testing conditions combined followed almost the same order; cucumber, cherry tomato, bell pepper, cauliflower, squash and red cabbage. However, increasing vegetable consumption by several grams daily may have a significant impact on public health, regardless of the vegetable type (familiar or unfamiliar). The high intake of cucumber in all testing conditions, may be a result of the vegetable being familiar, but also that the experimenter used cucumber to demonstrate the use of the eating utensil in all testing conditions. Children may have modelled this behaviour in the subsequent meal.

6.3 OBJECTIVE 2: PLAYFUL EATING UTENSILS' IMPACT ON VEGETABLE WASTE

The vegetable waste can be considered high when using the playful eating utensils, with a mean of 42 grams of leftovers per child when using the flexible skewer and 34 grams of leftovers per child when using the landscape plate. In a vegetable meal involving twenty children, this could lead to 840 grams of vegetables wasted per meal. However, the standard deviations were high, meaning that average variation around the mean was large and conclusions based on the present data set is therefore challenging. The possible increased waste production is likely due to the play situation and focus on vegetables as crafting compounds, in addition to the instructions to serve one selfes and that it is OK not to eat up. The food waste is not a surprising result of the play situation, but these insights must be considered when giving practical advice. The results showed that significantly more vegetables were wasted when children used the flexible skewer, compared to the other testing conditions. This finding suggests that the skewer significantly enhances consumption, but also increases the amounts of leftovers as the children served themselves with significantly more vegetables. The flexible skewer encouraged children to put on a greater amount of vegetables compared to the other utensils. It was observed that the children filled up the flexible skewer, then emptied it and started the crafting again- without eating or tasting any of the vegetables (Appendix K). A possible solution may be to revise the flexible skewer design to a shorter length, keeping the playful property, but reducing the space for vegetables. Individual differences were however observed - some children ate the whole craft before they started off crafting again.

Worry about throwing away food is reported as a barrier for serving of vegetables in kindergartens (Thurmann-Nielsen, 2011). Food waste is an emerging environmental problem and kindergartens must find ways to decrease the waste as much as possible using different methods. Discussing these methods is however a topic outside the scope of this thesis and more research with a higher number of observations is needed to investigate waste production in playful meals.

6.4 OBJECTIVE 3: MEASURING FAMILIARITY TO VEGETABLES DIRECTLY WITH 4-6-YEAR OLD CHILDREN: PICTURE SORTING TASK

The comparison of parental and children's reports and consumption in the testing conditions indicates that measuring familiarity to foods directly with 4-6-year old children can work as a valid method in research. The ID-numbering showed that 68 of the 73 children who conducted the picture sorting task, had a parent answering the questionnaire and the parent-child match was therefore considered high. The overall results from parental and children's reports corresponded, with the same three vegetables scoring highest on both familiarity and exposure (carrot, cucumber and bell pepper) and nearly the same three vegetables scoring lowest (children reported lowest familiarity to eggplant, artichoke and beetroot and parents reported lowest exposure to artichoke, eggplant and purple cauliflower). The comparison of familiarity reported by the children and their actual consumption corresponded. The same three vegetables used in the test that scored highest on familiarity (cucumber, bell pepper and cherry tomato) also had the highest consumption rates and the vegetables in the test with the lowest familiarity score (red cabbage, squash and cauliflower) had the lowest consumption rates. Measuring familiarity directly with children may be a good indicator of previous exposure and reports from 4-6 year olds are likely less affected by social desirability biases, compared to parental reports (Hebert, Clemow, Pbert, Ockene, & Ockene, 1995).

It is however important to consider that the children and parents did not get the same questions. The children were asked if they had tasted or not tasted the vegetable before (ever) and parents were asked about the child's recent consumption of vegetables. The questions were different because they were adapted to cognitive ability and memory functions. Types of vegetables consumed are often based on season. The parents were asked about consumption in December, January or February and some vegetables, like fresh mini corn, are not available in stores at that time of year whereas others, like beetroot (pickled), are more common in this season. Further, the results from the questionnaire and picture sorting are not clearly comparable because children may have tasted a vegetable once and remember it even though the exposure frequency is low. For instance, many children reported to have tasted brussels sprouts, but the exposure reported by parents was low. It is also clear that some vegetables are hard to recognise for children. The exposure to garlic was high, but 78.1% of the children reported not to have tasted garlic before. This may indicate that the children get garlic served prepared/cooked and as part of a dish, and that they do not see the actual vegetable in its natural form. This indicates that

exposure frequency may only relate to the child familiarity for minimally processed vegetables. Further, this may indicate that the children do not participate in cooking and preparations of foods.

The picture sorting task had some limitations. Some of the children had problems differentiating between "tasted before or not tasted before" and "like and not like". The youngest children had more challenges during the test than the oldest children. However, if the experimenter or assistants picked up on this misunderstanding, he/she explained the task again and due to the higher number of participants this is not assumed to have affected the results.

Children may not recognize the vegetable because of the way it is presented in the photo. They may have concluded that they have not tasted the vegetable because it looks different when its presented whole or children can have tasted the vegetable unknowingly in a prepared dish or product. For example, in Norway beetroot are often served pickled. Children who have not participated in cooking may never actually see how the vegetable looks in its natural form. Real vegetables could have been used, but pictures have been reported to work in similar studies and especially in this age group, when language is still under development, and vegetable names can be difficult to remember for children (Nilsen, 2010). For example, it was observed that several of the children called asparagus and asparagus beans for "bamboo". The picture sorting task should be further tested to establish reliability (test re-test) and concurrent validity (for instance familiarity tested with photos compared to familiarity tested with real vegetables).

The results from the familiarity testing reflected the overall consumption of vegetables in the testing conditions and strengthens the validity of the picture sorting task, as familiarity predicts consumption (Birch, 1979). The consumption and familiarity of cauliflower did however differ, indicating that children remember to have tried this vegetable before, but may not have developed a preference/liking for this vegetable yet. The familiarity and consumption of squash did also differ. This may be caused by children misperceiving the picture of squash for cucumber (it was observed that children said "Oh, that's cucumber- I've tasted cucumber before", when looking at the picture of squash), or that children are used to having squash served cooked and not raw and therefore shows lower willingness to taste squash in the test meals. Conclusively, the present study indicates that the picture sorting may be a valuable tool for measuring familiarity to vegetables, but the method need further validation and testing.

6.5 DISCUSSION OF METHODS AND STUDY DESIGN

6.5.1 Sampling method, participation and collection of data on group level

The number of participations in the study was high, and the study activities involved a total of 113 children. Eighty-two of these children tested all three utensils. Ideally, the within-group crossover design should have only included results from the same study participants. Data were collected at group level and over all kindergartens and group means were used in the analysis. Therefore, it was not possible to sort out individual data from the analysis and measures were based on the children present at the testing day. There was however no reason for presuming that the drop-outs were of systematic character and the high number of participants is assumed to control for variations in study participant characteristics (for instance when a bell pepper-loving child participates in one testing condition, but not in the other testing conditions). In one of the kindergartens, the group only consisted of ten children and due to the small group size, variations in participants can have affected the results more in this kindergarten. In pooled data however, all kindergartens confounded, and such effects are expected to play a minor role.

The original plan was to conduct data on individual level, as individual comparisons would had given more precise data on the impact of the utensils. The photographic method planned for collecting individual data was however not suitable for the group meal situation, as it was considered interrupting and unnatural. An alternative could have been to serve each child a standard portion of vegetables and compare a photo of a standard selection and portion to photos of the plates after the meal. This method would however not have given any information on the impact of self-servings. Giving children a standard selection and portion would have limited the children's feeling of autonomy, choice and possibly creativity, as the children would not have the opportunity to choose vegetables themselves.

6.5.2 Testing of eating utensils

A challenge to the testing procedure was to make all testing conditions as consistent as possible at each testing. The experimenter and the assistants were trained to follow the protocol, but the kindergarten personnel did not go through training before the tests and only followed instructions given at the test day. The possibility of the kindergarten personnel showing more

excitement when using the new utensils, cannot be ruled out. However, the kindergarten personnel often differed between test days in each kindergarten and the impact of enthusiasm on the result is presumed to be distributed evenly between testing conditions, as enthusiasm also can be a reaction when seeing the children participating in a research project and not just because of a new eating utensil. Other factors, like day of the week, length of the meal, time of the day, table setting, and number of participants were successfully consistent, except for one kindergarten that changed location each week (between two small houses). However, all other factors, like participants and kindergarten staff, were consistent so the change of location is not assumed to have significantly affected the data from the present kindergarten.

As previously mentioned, repeated exposure is the most effective method for developing preference for vegetables (Caton et al., 2013). To control for the effect of repeated exposure, all kindergartens tested the utensils in different orders. Otherwise a form of "carry over effect", with possibly higher consumption of vegetables the last testing day compared to the first testing day, due to familiarisation through exposure, could have biased the results. Visual exposure to foods has shown a positive effect for increased acceptance for foods in young children (Houston-Price, Butler, & Shiba, 2009) and seeing the vegetables on picture cards before consumption could also have affected the results, but this effect is also controlled for by the randomized order.

6.5.3 Parental questionnaire

The parental questionnaire had a high response rate. The possibility of answering the questionnaire electronically, through computer, smart telephone or tablets, and that the link was sent out directly to the parent's e-mail, are assumed to contribute to the high response rate. In hindsight, the questionnaire could also have collected data on socioeconomic status. However, as no individual data was collected, it would not have been possible to make any conclusion on socioeconomic effects. Moreover, the questionnaire was only presented in Norwegian and this may have caused drop-outs because of language barriers. However, the aim of this study was not to examine the effect of socioeconomic differences or ethnicity and the high respondent rate shows that making the questionnaire short and easy was a good decision given the need for getting data on exposure within the time frame.

To make children's and parental reports more comparable, the questions could have been formed differently. In hindsight, the questionnaire could have included both frequency of recent exposure and questions on whether their child had tasted or not tasted the vegetables used in the picture sorting task before (ever). This would have allowed a more direct comparison with the picture sorting task and may be interesting to test out in future studies for validation purposes.

6.5.4 Data entering and statistical analysis

The data were entered in Excel and analysed in SPSS. Entering data by hand can be a source of random error. The data were however controlled twice before conducting the analysis. In the statistical analysis, interpretation of significant effects was set to p-values $p<.05$ and $p<10$. The p-value varies with whether there is an effect or not in reality, but also with the number of observations and the noise level in the measurements (Altman, 1991). Interpretation of effects based on the $p<.05$ limit alone has two errors: 1) Even tiny, insignificant effects will have a $p<.05$ if there are thousands of observations, because, with a high number of observations, noise has less impact on the calculation of p-values. The effect is not necessarily bigger or more relevant to community actions, but the results are more statistically significant than with 100 or 10 observations. 2) Even real effects will have a $p>.05$ if the number of observations is low. The effect is not necessary less or less relevant to community actions, but it is less statistically significant. If the mean values clearly differ, but the data includes few observations with high levels of noise, the p-value may not show significant differences (Stoney & Lee Johnson, 2012). This may be the case in this study, with only six kindergartens/cases included in the data analysis and high standard deviations for some of the results.

6.6 EXTERNAL VALIDITY

The results are generalizable to other similar shared meal settings with 4-6-year old preschool children, in particular in other kindergartens. Five of the kindergartens had participated in a taste study in 2014. This may indicate that the sample presents kindergartens with more motivation when it comes to children's healthy eating. Other factors that can impact vegetable

consumption in a kindergarten, like economic, political, sociocultural and physical factors (Himberg-Sundet et al., 2018) are not accounted for in the present study.

It is important to bear in mind that the results are based on group means and cannot be generalized to the individual child. There are big individual differences when it comes to vegetable acceptance and level of food neophobia and some methods have a great impact on some children, but no effect on others. Simply changing the utensil may not be the answer for food neophobic children. Even so, as social influence is important for development of preferences (Lowe, Horne, Tapper, Bowdery, & Egerton, 2004), seeing other children enjoy vegetables and participating in the meal may be a step towards acceptance for the individual.

6.7 STRENGTHS AND LIMITATIONS

A limitation to the present study was that, due to drop-outs, a clear within-group crossover design was not achieved. Further, the study was narrow in terms of the types of utensils included. More research is needed to compare the effect of utensils designed to promote crafting and play and other alternative eating methods presenting novelty in the eating situation, to test whether it is the *novelty* of the eating method or the actual *eating utensil* that affects consumption. The data only included six cases and the small number of observations makes conclusions based on the data challenging. Further, it was not possible to blind the participants or the experimenter to the testing conditions and the experimenter's, children's, assistants' and kindergarten personnel's expectations may have affected the results by expecting the playful eating utensils to increase consumption. The aim of this study was to examine the immediate impact in a shared meal situation and further research on individual and sustained effects are needed. However, the group design was suitable for answering the research question. The aim was to examine the effect of the utensils in a group setting and mean intake on group level was therefore a suitable way for exploring this matter. The decision to only collect data on group level and not on individual level, as stated in the draft protocol, was considered an important and necessary decision for the progress of the study.

The overall strengths of the study were the high number of participants through all testing activities, the crossover design with different orders of testing conditions and the inclusion of pre- and pilot testing. Six kindergartens participating was beneficial because all orders of the three testing conditions could be tested. The pre- and pilot testing was highly beneficial for the

main data collection. The high level of planning and testing of methods before the main study made the data collection structured, and hence; no data had to be ruled out from the data analysis. The study protocol enhanced consistency through the testing conditions and minimized the effect of confounders. Further, a strength of the study was the testing in a natural environment. A laboratory experiment could not have given the same practical implications, as shown by the many changes made to the study protocol after the pilot testing in a kindergarten. Another strength was the use of weight as a measure for food consumption. This is stated to be the most accurate method for measuring food intake in children (Burrows, Martin, & Collins, 2010). Last, a strength was that the experimenter (the master'student/the author/me) led and attended all study activities, including every testing, and got deep insights in strength and limitations during the whole research process.

6.8 IMPLICATIONS

6.8.1 Play and crafting with vegetables

Findings from the study are important, because methods that can encourage exposure to vegetables in 4-6-year old children, who are known to be reluctant to taste vegetables, can facilitate the adoption of healthful vegetable consumption (Coulthard et al., 2018). Biological aversions to the bitter taste properties of vegetables can be overruled through repeated taste exposure and creation of positive association, possible resulting in promoting development of preferences. Methods that increase the number of tastings and overall sensory exposure, through sight, smell, touch and sound, can contribute to the development of vegetable preferences. Exposure in a familiar environment, with peers joining the same activity, can contribute to even more positive associations towards eating vegetables. Repeated tasting sessions like these may also in turn affect food neophobic and picky children. Promoting acceptance to a variety of vegetables in childhood might further contribute to higher levels of consumption through life and lower incidents of NCDs in the population.

The overall intake of vegetables in the test meals, with a mean of 190 grams, was high considered that the mean daily intake of both fruit and vegetables combined for 4-year-olds in Norway is 230 grams a day (Hansen et al., 2017). This indicates that a 35-45 minutes meal with vegetables in the kindergarten has the potential to increase children's daily intake of vegetables

with 190 grams a day, leading to 86 % higher fruit and vegetable consumption daily, compared to no vegetable meal in kindergarten, assuming stable intakes in other daily meals. Over time, an extra vegetable meal a day, can lead to a substantial increase in intake for the child, regardless of the home environment. The results indicate that kindergartens may should prioritize a vegetable play activity to promote children's exposure and possibly impact children's liking and consumption of vegetables.

The high overall intake also indicates that previous findings on serving styles of vegetables to children work in practice. Presenting the vegetables chopped in bites and served in small bowls, that ensures accessibility for all the children, with the instruction to taste and eat what they want, may help to increase the consumption.

6.8.2 Modern table manners?

It was observed that many of the children were surprised that they were allowed to play with the food. Table manners often include the instruction to eat without too much spills, eat up what is on the plate and not throw away unnecessary amounts of foods. These are common norms, but in terms of making children taste vegetables it may not be the best method. Strict messages when it comes to food intake may decrease the child's opportunity to explore new foods. If a meal is largely influenced by many rules and there is no room for testing, this can inhibit the children's curiosity and play (Langholm & Tuset, 2013). There is however a need for finding a balance to interpret these findings, as free playing can lead to both higher levels of food waste and noise affecting the eating environment negatively.

6.8.3 Exploring vegetables in shared kindergarten meals

The study suggests that vegetables should be served in a way that promote creativity, participation and exploration of vegetables by the use of hands, possibly through the use of an alternative eating utensil. This can be done by giving the children the opportunity to make vegetable crafts using their own imagination and vegetables of their own choice. This may in turn lead to more vegetables being wasted. Therefore, short "playing and crafting sessions", for instance two times a week could be a solution. In these sessions it is allowed to play, craft and taste vegetables without the involvement of adults or the pressure to eat up. It is also suggested

that these sessions can involve a "novelty element" that presents the vegetables in a way the children have not seen before, for instance by eating the vegetables from a skewer.

It seems that the child expresses desire to eat different foods in the kindergarten than at home (Langholm & Tuset, 2013). Children get affected by kindergarten personnel's and peers' attitudes and behaviours towards vegetables, through the learning process of modelling, and combined with exposure, this gives the kindergartens potential for affecting children's taste development. A kindergarten environment, which encourages tasting of vegetables through fun activities, can help children create positive associations to vegetables. Tasting in a setting away from home can be especially important because food preferences are affected by factors at home like parental food neophobia, socioeconomic status and education (Birch, 1999; Köster & Mojet, 2006; Ventura & Worobey, 2013; Yeomans, 2006)

Insights from the present study can complement practical interventions for promoting vegetable consumption in preschool years. Play sessions are assumable effective combined with other strategies for promoting vegetable consumption (Hoppu, Prinz, Ojansivu, Laaksonen, & Sandell, 2015). This recommendation is in line with other studies. Cirignano and colleagues concluded in a 2014 review by recommending taste-testing events coupled with nutrition information as an effective strategy to increase acceptance of new, healthy foods for children from kindergarten through the 6th grade (Hughes, Cirignano, & Fitzgerald, 2016). A review from 2018 summarized and evaluated recent research investigating taste exposure, sensory learning and nutrition education intervention for promoting vegetable intake in preschool children (Nekitsing, Hetherington, & Blundell-Birtill, 2018). The authors concluded that to strengthen intervention effects for improving vegetable intake in preschool children, future practice should consider integrating taste exposure and sensory learning strategies with nutrition education within the preschool curriculum (Nekitsing et al., 2018).

6.9 IMPLICATIONS FOR FUTURE RESEARCH

Future research examining the effect of playful meals in kindergartens, should include a higher number of kindergartens if examined on group level or the measures should be on individual level so that each child presents one case. Looking on trends in the data can give implications for future research. For instance, there was a trend towards increased consumption when using

the landscape plate compared to the white plate (p=.13), with a mean of 32 grams more vegetables consumed per child.

The increased amounts of self-servings and consumption of vegetables when using the flexible skewer and the landscape plate may be related to the novelty of the utensils. The first exposure to an odd and new eating utensil may produce a heightened response in intake and servings. More research is needed to test if the results are due to the actual eating utensil or the fact that the utensil presents a "novelty" in the eating situation. Future research should track the success of using playful eating utensils repeated over time, compared to strategies which vary in novelty. These methods should be tested both on individual and group levels. If this kind of easy environmental change, or nudge, characterized by moving away from traditional eating utensils to more playful eating utensils, is shown to be effective over time, the insights can give important contributions to designing interventions for increasing vegetable consumption.

Further, it has been reported that there is a gap in the evidence base to promote vegetable intake in picky children (Nekitsing et al., 2018) and playful eating utensils should be tested to examine the individual response for children with high levels of food neophobia or picky eaters.

It would also be interesting to examine the effect on tasting through observational methods (for instance counting number of times the child touches the food with his/her mouth/tongue). Taste exposure is important for developing preferences, and the present study only examined self-servings as a possible indicator of tasting and multisensory exposure. Further, it would be interesting to investigate whether playful eating utensils can impact children's attitude towards and liking for vegetables immediately and over time, as attitudes and liking predict consumption (Bere & Klepp, 2005). This could give more insights into the establishment of positive associations and the sustainability of these associations over time. Last, further validation of the picture sorting task as a tool for measuring young children's familiarity to vegetables is needed.

7 CONCLUSION

The present study supports previous findings that suggest that playing and crafting with vegetables and participating in hands-on activities with vegetables, can promote children's consumption. The findings suggest that playful eating utensils, that promote creativity, participation and autonomy in a meal situation, can increase immediate consumption of vegetables in shared kindergarten meals, compared to a traditional eating utensil. Eating vegetables from a flexible skewer tends to be an especially effective method for increasing consumption of familiar vegetables. The playful eating utensils did not impact consumption of unfamiliar vegetables. The overall waste (leftovers) produced when using the playful eating utensils was high, indicating a challenge for using the utensils on an everyday basis. Further, the results indicate that measuring vegetable familiarity directly with 4-6-year-old children, through picture cards, is a promising method, but further validation is requested.

The number of observations in the study is low and the results should be interpreted with caution. More research is needed to test whether the findings generalize to other playful eating utensils and to examine long-lasting effects and effects on individual level, especially for those children who show reluctance towards eating vegetables.

AFTERWORD

I found planning and conducting this study and writing this thesis to be both fun, challenging and instructive. I am proud that I managed to plan and implement a research project from start to finish, and that I managed to recruit over one hundred children and coordinate twenty testing days (pre-test, pilot test and 18 visits to kindergartens). I have gained a lot of experience in coordinating tests in kindergartens and learned that double- (and triple)-checking and structured planning is essential for carrying out research in real-life environments. I have learned a great deal from both undertaking and processing quantitative research and learned not to be afraid of unfamiliar terrain (like SPSS), as this is precisely where one learns the most.

It has also been exciting that the study has gained interest in various environments, and also that the study was presented at NRK in the TV-program, *Norge Nå*, April 10, 2018 (https://tv.nrk.no/serie/norge-naa/ENRK10041018/10-04-2018). A live broadcast from Nofima focused on the research behind development of taste, on how what you eat in young years lay the foundation for how you eat later in life, and on how parents can make their children eat healthy. The utensils in this study were presented and discussed.

The next step in the process is to write a scientific publication together with a postdoctoral fellow. Hopefully, publishing the results can contribute to research on sensory play and the topic of exposing children to vegetables through joyful play activities in kindergarten.

Julie Aass

Oslo, May 2018

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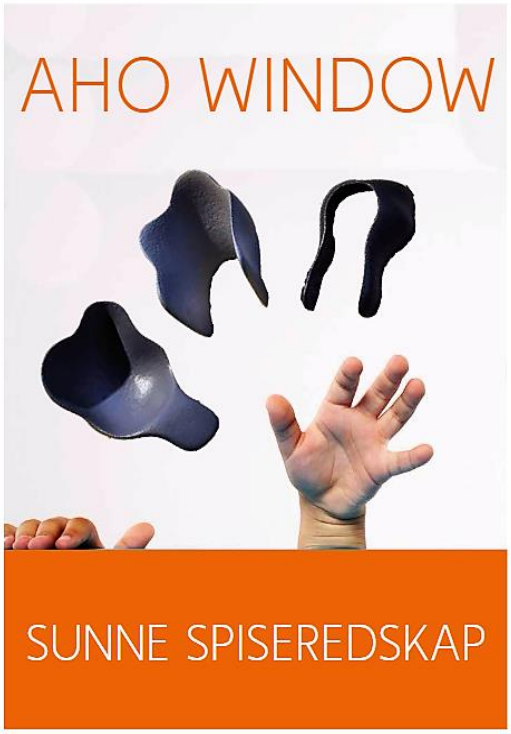
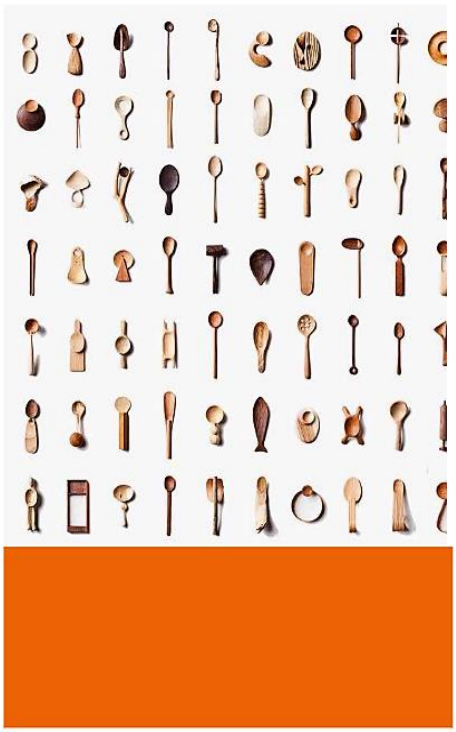
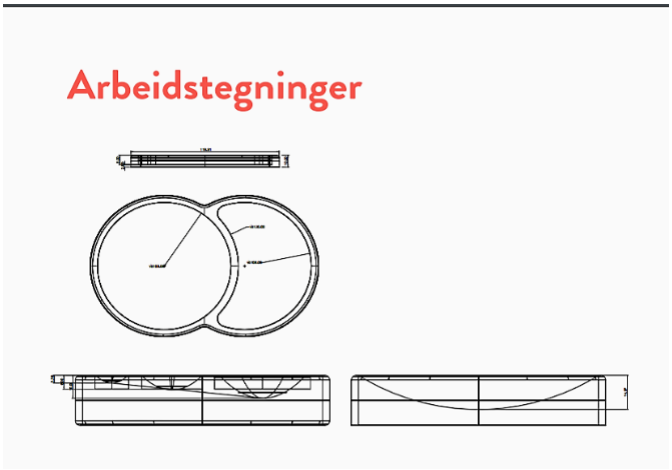
APPENDICES

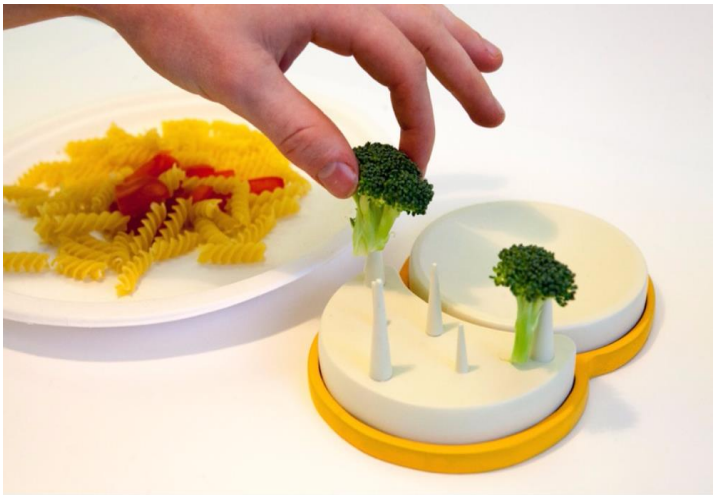
Appendix A: Project AHO/Nofima: Eating utensils for healthy eating.





Appendix B: Development and testing of early prototypes (AHO)





Appendix C: NSD approval and copy of report on adjustments in protocol

Asta Bye
Postboks 4 St. Olavs plass
0130 OSLO

Vår dato: 06.10.2017 Vår ref: 56088 / 3 / EPA Deres dato: Deres ref:

Tilbakemelding på melding om behandling av personopplysninger

Vi viser til melding om behandling av personopplysninger, mottatt 20.09.2017.
Meldingen gjelder prosjektet:

56088	*Testing of eating utensils to promote fruit and vegetable intake in preschool children*
Behandlingsansvarlig	*Høgskolen i Oslo og Akershus, ved institusjonens øverste leder*
Daglig ansvarlig	*Asta Bye*
Student	*Julie Aass*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database.

Personvernombudet vil ved prosjektets avslutning, 31.08.2018, rette en henvendelse angående status for behandlingen av personopplysninger.

Dersom noe er uklart ta gjerne kontakt over telefon.

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 56088

INFORMASJON OG SAMTYKKE

Utvalget (foreldre) informeres skriftlig om prosjektet og samtykker til deltakelse. Informasjonsskrivene er godt utformet, men vi ber om at følgende endres/tilføyes:

- Det er vedlagt to informasjonsskriv og vi ber om at begge inneholder den samme informasjonen om metode, deltagelse, hva skjer med persondata og prosjektslutt.
- I informasjonsskrivet med bilder skal det stå at prosjektslutt er 31.08.2018 og det skal informeres om at datamaterialet skal anonymiseres innen denne datoen, jf. informasjonen i meldingsskjemaet.
- Vi ber om at det er koordinert og korrekt informasjon om hva deltagelse innebærer for barna i begge informasjonsskrivene.

En del av utvalget i prosjektet er barn, og det er foreldrene deres som samtykker til deltakelse. Likevel bør barna få informasjon om prosjektet som er tilpasset deres ordforråd. Det er også viktig at barna får informasjon om at de kan velge å ikke delta i prosjektet hvis de ønsker det, selv om foreldrene har samtykket.

INFORMASJONSIKKERHET

Personvernombudet legger til grunn at student/forsker etterfølger Høgskolen i Oslo og Akershus sine interne rutiner for datasikkerhet.

PROSJEKTSLUTT OG ANONYMISERING

Forventet prosjektslutt er 31.08.2018. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:

- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)

Hei,

Viser til endringsskjema registrert hos personvernombudet 01.11.2017.

Vi har nå registrert at det legges til et kort elektronisk spørreskjema til foreldrene til barna som deltar i studien. Endringsmeldingen er blitt behandlet som en orientering, og ikke en reell endring. Personvernombudet forutsetter at prosjektopplegget gjennomføres i tråd med det som tidligere er innmeldt, og personvernombudets tilbakemeldinger. Vi vil ta ny kontakt ved prosjektslutt.

Med vennlig hilsen

NSD – Norsk senter for forskningsdata AS | NSD – Norwegian Centre for Research Data

Appendix D: Invitation mail to kindergartens

Hei,

Matforskningsinstituttet Nofima, i samarbeid med Designhøgskolen i Oslo og Akershus og Institutt for sykepleie og helsefremmende arbeid ved Høgskolen i Oslo og Akershus, søker deltagere til et mastergradsprosjekt om metoder for å øke barns aksept for grønnsaker.

I den forbindelse ønsker vi å invitere (barnehagens navn) barnehage til å delta i studien.

Hva innebærer deltagelse i studien?

Prosjektet går ut på at barn i alderen 4-6 år skal ***teste nye spiseredskaper***, som er spesielt utviklet og designet for barn. Selve undersøkelsen vil foregå i barnehagen i barnehagetiden ***én gang i uken i tre uker i november/desember 2017 eller januar/februar 2018***. Barna skal teste tre ulike spiseredskaper under normal måltidssituasjon sammen med de andre barna som deltar i studien. Grønnsaker vil bli servert i ulike boller og barna kan forsyne seg og spise det de selv ønsker. Barnas inntak vil måles på gruppenivå ved veiing av mat og på individnivå gjennom bilder av tallerkener før og etter måltid. Vi ønsker også å teste barnas kjennskap til ulike typer grønnsaker gjennom en lek der barna plasserer bilder av frukt og grønnsaker i ulike kategorier.

Masterstudenten (jeg) og to andre studenter vil gjennomføre testingen. Vi vil trenge noe assistanse fra barnehageansatte, blant annet for å identifisere barna som deltar i studien. Nofima står for all servering av grønnsaker og dekker alle kostnader knyttet til prosjektet**. *Totalt antall besøk fra oss i barnehagen vil bli 3/4 ganger.***

Hovedfokuset vil ligge på økt matglede og utvikling av sunne spisevaner gjennom barnas egen lek og fantasi. Vi har stor tro på at dette vil være både et morsomt og helsefremmende prosjekt å være med på.

Vi håper på positiv tilbakemelding og tar gjerne et møte for å informere om videre detaljer.

Se også vedlagt informasjon til foreldre.

Med vennlig hilsen

Julie Aass

Masterstudent, Høgskolen i Oslo og Akershus

Antje Gonera

Seniorforsker, Nofima

antje.gonera@nofima.no

Valérie Lengard Almli

Seniorforsker, Nofima

valerie.lengard.almli@nofima.no

Appendix E: Information letter and letter of informed consent to parents (example)

Vil ditt barn være med å teste nye spiseredskaper i barnehagen?

Forskning: Kan spesialdesignede spiseredskaper øke grønnsaksinntaket hos barn?

Testing av nye spiseredskaper i barnehagen!

Dette er en forespørsel til deg som foresatt om hvorvidt ditt barn kan delta på testing av nye spiseredskaper i barnehagen. Vi ønsker å undersøke om morsomme spiseredskaper kan bidra til å øke barns inntak av grønnsaker. Testingen inngår i en mastergradsstudie i Samfunnsernæring i samarbeid med matforskningsinstituttet Nofima, Designhøgskolen i Oslo og Akershus og Institutt for sykepleie og helsefremmende arbeid ved Høgskolen i Oslo og Akershus. Vi søker barn i alderen 4-6 år i barnehager i Akershus kommune. Målet med studien er å få bedre innblikk i hvordan vi kan få barn til å spise mer grønnsaker gjennom lek.

Hva innebærer deltagelse i studien?

Selve testingen vil foregå over tre forskjellige dager i barnehagen i barnehagetiden på **fredager** i januar. Datoene for testing er **5., 12. og 19. januar**. Ditt barn vil få teste tre ulike spiseredskaper og bli tilbudt ulike typer grønnsaker sammen med de andre barna som deltar i studien. Barna velger selv hva og hvor mye de ønsker å spise av grønnsakene som tilbys. I tillegg vil ditt barns gjenkjennelse av ulike typer grønnsaker bli testet gjennom en lek der barna plasserer bilder av grønnsaker i ulike kategorier. Testingen utføres med fokus på barnets trivsel og i samråd med barnehagepersonalet.

Spørreskjema til foreldre

I forbindelse med testingen, håper vi at du har mulighet til å svare på et kort spørreskjema om ditt barns inntak av grønnsaker. Undersøkelsen tar kun noen få minutter og linken vil bli sendt per e-post.

Hva skjer med informasjonen om ditt barn og deg?

Alle personopplysninger vil bli anonymisert og behandlet konfidensielt. Den registrerte informasjonen innebærer barnets inntak av grønnsaker ved testmåltidene i barnehagen og bilder av barnets tallerken før og etter måltid, samt svar på testen om gjenkjennelse av ulike typer grønnsaker. Alle opplysningene vil bli behandlet uten direkte gjenkjennende opplysninger. Datamaterialet fra undersøkelsen vil i avidentifisert form være tilgjengelig for forskerne som arbeider med studien, og kan senere bli brukt i vitenskapelige og populærvitenskapelige artikler og presentasjoner. Det vil ikke være mulig å identifisere barnet eller foresatte i resultatene av studien hvis disse publiseres.

Frivillig deltagelse

Det er frivillig å delta i studien. Både du og barnet ditt kan når som helst, og uten å oppgi noen grunn, trekke deres samtykke til å delta i studien. Hvis du godkjenner at barnet deltar, vil barnet også ha mulighet til å selv takke nei når testingen utføres. Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

Informasjon om utfallet av studien

Deltagerne har rett til å få informasjon om utfallet/resultatet av studien når den er avsluttet.

Spørsmål og kontaktinformasjon

Dersom du har spørsmål til testingen, ta kontakt med masterstudent, Julie Aass, på mobil: 922 57 294 eller på e-post: s198273@stud.hioa.no, eller veiledere ved Nofima, Valérie Lengard Almli, på e-post valerie.lengard.almli@nofima.no og Antje Gonera, på e-post antje.gonera@nofima.no

Vi håper at vi sammen kan bidra til mer kunnskap om hvordan vi kan øke grønnsaksinntaket hos barn!

Med vennlig hilsen,

Julie Aass	**Antje Gonera**	**Valérie Lengard Almli**
Masterstudent, HiOA	Seniorforsker, Nofima	Seniorforsker, Nofima

Samtykke til deltagelse i studien

SVARFRIST 22. desember (leveres i barnehagen)

☐ **Jeg godkjenner at mitt barn kan delta i studien.**

Barnets navn:

_____

I tilfelle matallergi: Mitt barn er allergisk mot:

_____

Min e-postadresse er:

_____

Obs! E-post vil kun benyttes til å sende deg linken til et kort spørreskjema om ditt barns inntak av grønnsaker.

_____

(Signert av barnets foresatt, dato)

Appendix F: Information letter to research assistants

Skriv til medhjelpere ved mastergradsprosjekt

Testing av spiseredskaper i barnehager

Kort om masteroppgaven: Masteroppgaven handler om hvordan vi kan øke grønnsaksinntaket hos barn. Forskning har vist at smakspreferanser dannes tidlig i livet og legger grunnlaget for matvaner senere i livet. Oppgaven skrives i samarbeid med Nofima, hvor det forskes mye på utvikling av smakspreferanser hos barn. Hypotesen er at «lek med mat» kan bidra til at barn tør å smake på og spise ukjent mat. Nofima ønsker å teste om spesialdesignede spiseredskaper, som oppfordrer til å leke/ta på maten, kan gjøre at barn spiser mer grønnsaker og/eller flere typer grønnsaker.

I masteroppgaven skal to spiseredskaper testes og sammenlignes med standard spiseredskaper (hvit papptallerken).

Vi besøker hver barnehage tre ganger og tester ett spiseredskap per gang. Vi handler inn, tilbereder og serveres grønnsakene selv og barnehagepersonalet skal ikke ha andre oppgaver annet enn å bidra til ro og orden.

Medhjelpernes oppgaver:

Kl. 10: Møtes ved Nofima. Kjører til butikken og handler inn grønnsaker.

Kl. 11-11.30: Skylle og skjære opp grønnsaker i Vegetabilhallen på Nofima. Veie mengde av hver grønnsak (ferdig oppkuttet) og registrere dette i gram.

Kl. 12.30/13.00: Kjøre til barnehage (får adressen på forhånd).

Kl. 13.30-14.30: Bistå ved organisering (se at riktig barn får riktig kode og får spiseredskapet med den riktige koden). Servere grønnsaker i barnehagen. Hjelpe til å holde orden og observere. Rydde opp. Samle rester av hver grønnsak i poser.

Kl. 15-: Kjøre tilbake til Nofima og veie opp restene av grønnsaker/vaske opp.

Jeg er med hele veien og gir instruksjoner underveis☺

Bildesorteringslek (aktuelt for de som skal jobbe følgende datoer: 05.01, 09.01, 10.01, 01.02, 02.02): Ved første besøk i hver barnehage skal det også gjennomføres en bildesorterings-lek, som skal teste gjenkjennelse av grønnsaker. Vi tester ett barn hver om gangen. Barnet får sitte ved et bord/på gulvet et sted det ikke forstyrres av andre. Barnet får utdelt bildekort med bilder av ulike grønnsaker, og vi legger et gult og et blått A4-ark foran barnet. Vi forklarer: «Hvis du har spist grønnsaken på bildet før, legger du bildet på gul farge. Hvis du ikke har spist grønnsaken før, legger du den på blå farge». Når barnet har sortert ferdig, registrerer vi svarene i et skjema.

NB: Medhjelpere må på forhånd ha sett gjennom navnene på grønnsakene, og kontrollere at de vet hvordan disse ser ut (se navn under).

Tusen takk for at dere hjelper til!

Hjertelig hilsen

Julie Aass

Appendix G: Register scheme for weighing of vegetables

Registreringsskjema testing

Barnehage:

Dato:

Ukedag:

Tidspunkt:

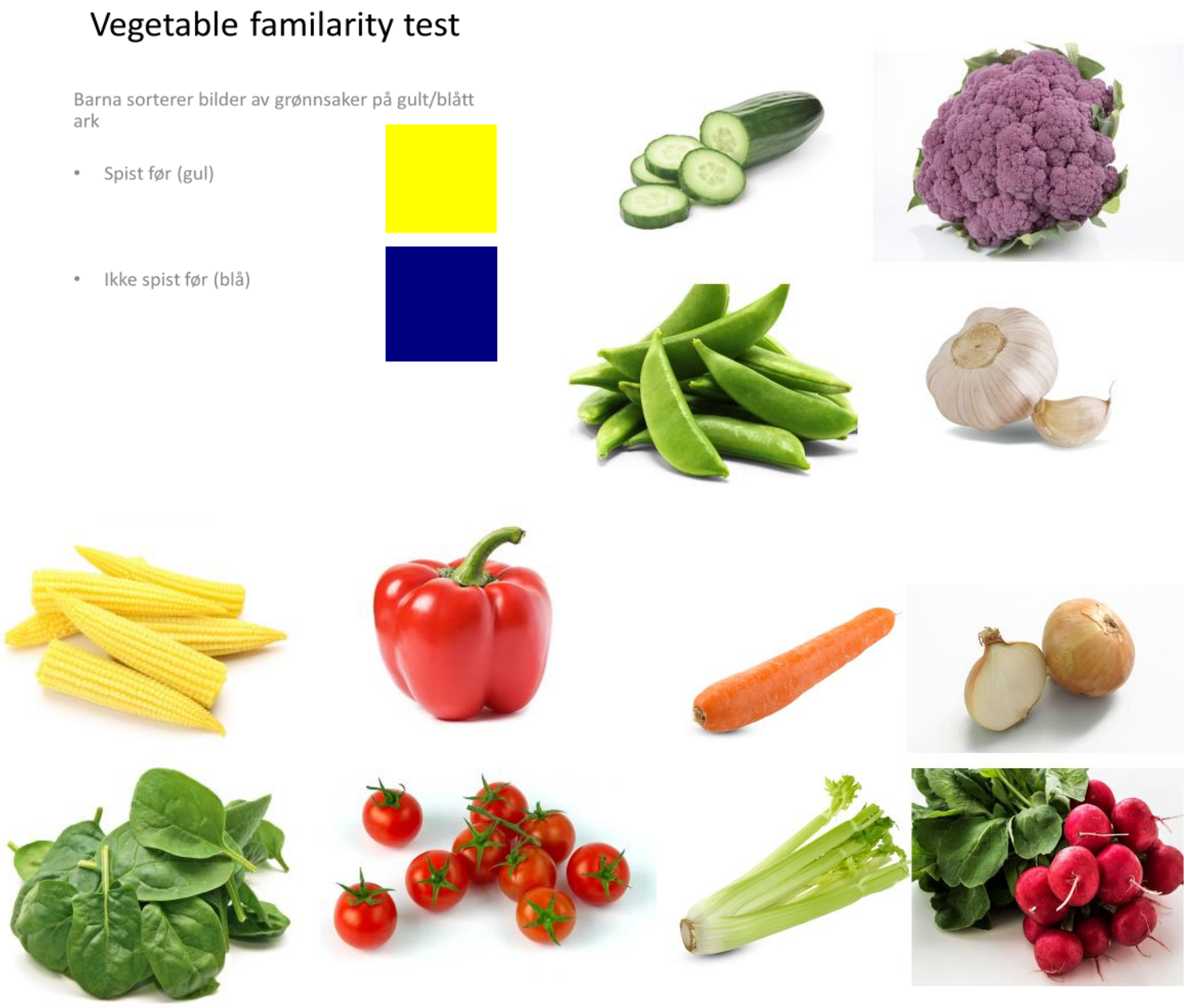
Spiseredskap:

Tidspunkt forrige måltid:

Antall barn til stedet:

Grønnsak	**Vekt start**	**Vekt slutt**	**Vekt kastet (etter sortering)**
Blomkål			
Cherrytomat			
Agurk			
Squash			
Paprika			
Rødkål			

Appendix H: Picture sorting task. Example of picture cards.



Appendix I: Parental questionnaire

Dette er et kort spørreskjema til deg som foresatt i forbindelse med testing av nye spiseredskaper og grønnsaksspising i barnehagen.

Spørreskjemaet inneholder spørsmål om ditt barns inntak av grønnsaker utenfor barnehagen. Det tar kun noen få minutter å fylle ut skjemaet.

Alle besvarelser behandles anonymt og konfidensielt.

Tusen takk for dine svar!

1: **Hva er barnets ID-kode (tilsendt på mail)?**

2: **I hvilket år er barnet ditt født?**

3: **Hva er barnets kjønn?**

Gutt
Jente

4: **Hvor ofte har barnet ditt spist dette i løpet av de siste 30 dagene (ikke medregnet det som serveres i barnehagen)?**

	Ikke spist de siste 30 dagene	**Et par ganger**	**Ca. en gang i uken**	**Flere ganger i uken**	**Daglig el. nesten daglig**
Hvitløk					
Minimais					
Cherrytomat					
Avokado					
Paprika					
Sukkerert					
Gulrot					
Agurk					
Blomkål					
Brokkoli					
Spinat					
Bladsalat					
Tomat					

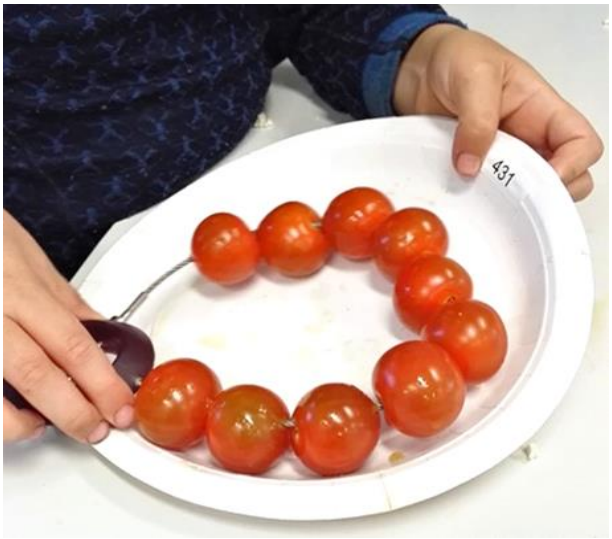
Hvor ofte har barnet ditt spist dette i løpet av de siste 30 dagene (ikke medregnet det som serveres i barnehagen)?

	Ikke spist de siste 30 da-gene	Et par ganger	Ca. en gang i uken	Flere ganger i uken	Daglig el. nesten daglig
Rødbet					
Løk					
Lilla blomkål					
Aubergine					
Asparges					
Rødkål					
Rosenkål					
Purreløk					
Artisjokk					
Stangselleri					
Squash					
Reddik					
Aspargesbønner					

Takk for din deltagelse!

Klikk 'Send inn' under for å fullføre spørreskjemaet.

Appendix J: Photos from the pre and pilot tests. When using the buffet, the children tended to only choose one vegetable bite a time. When the boxes were placed on the table, the children tended to only eat the vegetable in front of them/the nearest ones.



Appendix J (continued): Pilot testing in kindergarten. ID-numbers on stickers, note book for registering participants and table with boxes and flexible skewers ready for testing.

Appendix K: Playing and crafting with vegetables in main study.